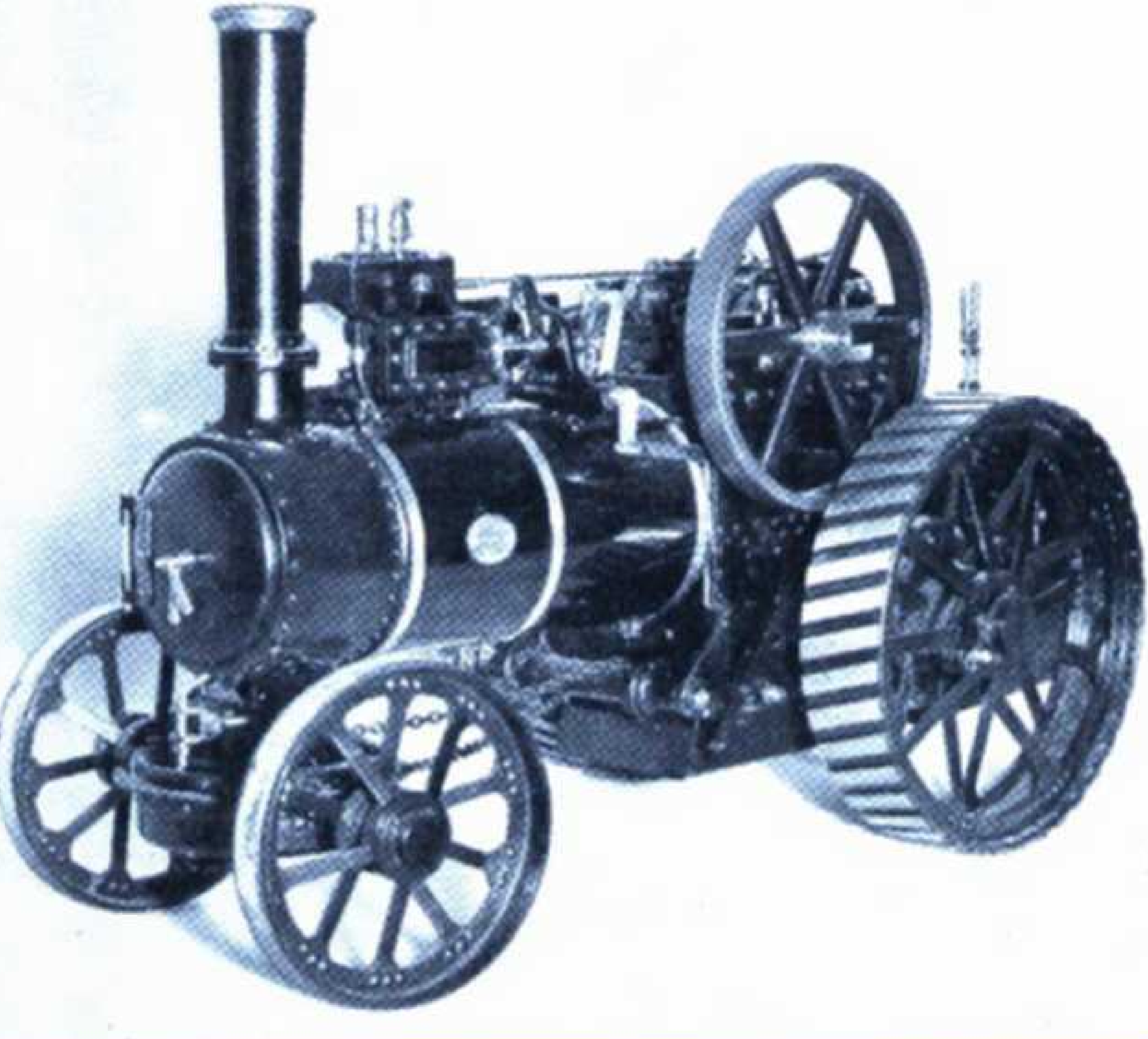
THE MODEL ENGINEER



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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

There were no fewer than fifteen model traction-engines at the recent Birmingham exhibition, although several of these were to free-lance designs. Of the others, probably the most true-to-prototype engine was the 1¼-in. scale Fowler built by A. E. Phillips, of the Birmingham club. This was a very nice engine, well built, and well finished.

Connoisseurs of traction-engines will note many of the details which are "true Fowler" in appearance. They included the little-end, cross-head and slide-bars, reversing-lever and quadrant, tender, draw-beam and cotters, and the fairlead.

The engine was, of course, of the single-cylinder general-purpose type, and was fitted with two-speed gear. It had obviously done some hard work, though we have no information as to what its haulage capacity actually is. The photograph was taken by "Northerner."

SMOKE RINGS

Little Ships—Big Achievements !

IN THE issue of May 14th, we published photographs and general particulars of two of the Navy's latest motor torpedo boats, *Bold Pioneer* and *Bold Pathfinder*, both of which are fitted with gas turbines in combination with diesel engines. Since then, we have been allowed to witness seagoing trials of the former craft in the Solent, and are very much impressed with her performance. The use of gas turbines enables the power/weight ratio of the plant to be increased to an extent hitherto unattainable in marine engine practice ; the diesel engines are used mainly for cruising and manoeuvring, and their power can be supplemented by that of the turbines when high speeds are required. Many of the details of the craft and its power plant are, of course, still on the secret list ; the official claim is that it is capable of a speed of "over 40 knots," and we should be inclined to regard it as a typical naval understatement, judging by the way it streaked past the observation boat, which was itself travelling at nearly 35 knots. The success of the gas turbine has been fully proved by extensive tests, and more boats of this type will undoubtedly follow. They are capable of taking over many of the duties which have hitherto required much larger and more fully manned craft, and their mobility, which is superior to that of any previous seagoing fighting ships, is an important asset either in peace or war.

Who Sent Them ?

WE HAVE received from the General Post Office a parcel bearing a blue label with the address : "Mr. B. T. Payne, Sparkhill, Birmingham." The Post Office had opened the parcel to see if there were any clues to the sender, to whom it could be returned.

The parcel, however, contains a number of loose copies of THE MODEL ENGINEER, which accounts for its being delivered to us ; it could not be delivered to Mr. Payne because it is insufficiently addressed. A search through the files of our Advertisement Dept. has also failed to discover any clue to either the sender or the addressee, so the parcel now rests in our office.

If this note should catch the eye of either the sender or Mr. Payne of Sparkhill, will he please get into touch with us ?

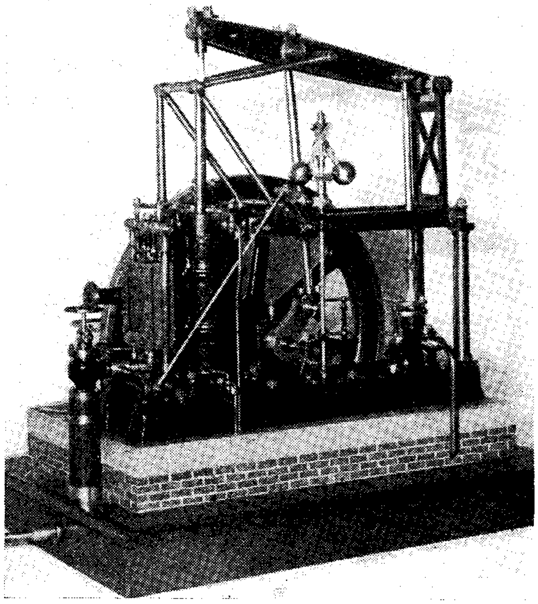
A New "M.E." Exhibition Trophy

AN OLD friend of ours, and a frequent exhibitor at the "M.E." Exhibition, is Mr. A. E. Bowyer-Lowe, whose particular interest is in tools and workshop appliances. He is a first-class craftsman and is especially anxious to encourage craftsmanship and design in workshop equipment. For this purpose, he has very kindly given us the handsome challenge cup seen in the photograph reproduced on this page. This fine trophy will be awarded at each "M.E." Exhibition to the best example of craftsmanship and design in the "Tools and Workshop Appliances" class.

In recent years, exhibits in this class have shown a tendency to decline in number and design, especially the latter which, in general terms, has deteriorated. To go to a lot of trouble to put a high finish on workshop equipment of any kind is wasted effort, for no amount of such finish can hide faulty design. We feel that Mr. Bowyer-Lowe's generosity should stimulate some improvement.

The Birmingham Exhibition

First impressions by " Northerner "



An elegant grasshopper engine by R. Stelfox, built to an old Model Engineer *design by Henry Muncaster*

IT was almost with a sense of dismay that I scanned my advance copy of the catalogue of the exhibition organised by the Birmingham Society. There were exhibits totalling nearly nine hundred, and it was my lot to report a few selected representative models from all this wealth. Some job !

Now obviously there must be a great many first-class models in such a big show, and, therefore, all that could be done in the space at my disposal was to pick exhibits almost at random. To those others, whose equally good (or better) work has had to be omitted, my apologies, together with my thanks for giving me a great deal of pleasure.

Locomotives

Among the 176 locomotives of 2½-in. gauge and over, one which took my eye was a neat American 0-4-0 industrial tank locomotive by H. Wilshaw. Finished in an attractive shade of green, with white lining and lettering, the locomotive was typical of American practice, although not so hung with accessories as some one has seen. (Talking of paint, by the by, the lining, lettering and numbers were good, but the green paint was a trifle " specky " as though either it could have done with straining before applying, or as if it had dried in a dusty place.)

The frames were of the bar type, and apparently slip eccentric reversing gear was fitted. The machining was good, and so was the finish of the other bright-work. An interesting and unusual feature was that the water-pump, mounted at the rear on the offside of the engine, was driven from a return crank on the extended crank-pin of the rear-wheel.

There was good attention to detail, which was well carried out—the buck-eye couplers, the dummy Westinghouse brake-pump, the dogs on the smokebox door, the bell, and so forth. Altogether a pleasing little locomotive.

Next under notice comes a chassis for a 5-in. gauge " Midland Compound." The standard of craftsmanship on this was extremely high, and A. J. Webb, of the Birmingham Society, is to be congratulated on the excellent finish he has attained, both on the machined and the hand finished parts. The plate-work was beautifully done, with excellent riveting ; the heads of the 3/64-in. rivets are slightly under-scale at present, but Mr. Webb reckons that when painted they will be just right. This is a point that some others might take into consideration !

Because this is to be a working model, of course, there will be one or two departures from the exact prototype, but it will be accurate in appearance as far as possible. This means that the detail work is receiving particular attention, and (as an example) the brake-gear and sanding-gear are superb.

Leaf springs are fitted to the rear driving axle, and compensated leaf springs to the bogie. Mr. Webb says it was a considerable job " working in " the three sets of Stephenson link motion between the frames, as well as the inside cylinder, but this has been done very neatly. By the way, boiler-pressure will be at least 120 lb. per sq. in., and perhaps 150 ; that is a point which has yet to be decided. This locomotive should be a good worker as well as a good looker when finished !

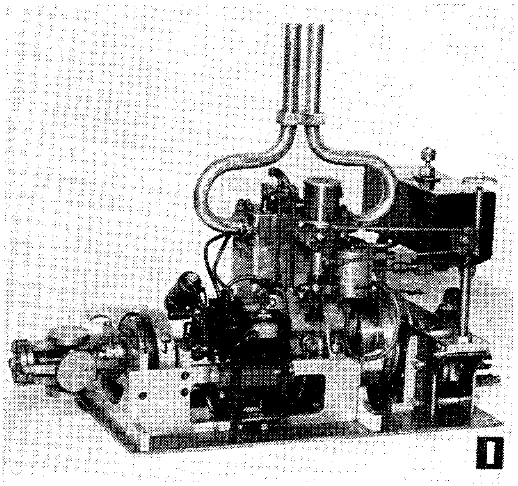
Steam Engines

A large number of steam-engines was also a feature of the exhibition, and twenty or more of these were shown working under compressed air throughout the week. Among the latter was a well-made " Grasshopper " engine by R. Stelfox, also of the Birmingham club.

This engine, of 1⅞-in. bore and 4½-in. stroke, was made from a design published in The Model Engineer of 1934 by the late Henry Muncaster, whose knowledge of steam engines was phenomenal. About two years of the builder's spare time was occupied in its construction, and the model was completed last year.

Most of the parts, including the beams and the rocking fulcrum link, are fabricated in steel, the separate pieces of each being pinned and brazed, and there are few castings in the whole job. For the latter, which include cylinder and flywheel, Mr. Stelfox made his own patterns, and had the castings made at a local foundry.

As will be seen, the fulcrum link is pivoted at the top of a pair of columns, which are stayed to the cylinder top by two girders. The crosshead is restrained to a vertical path by parallel motion, and has an open fork to carry its split brasses, which are adjusted by wedge and cotter. A similar bearing is fitted



(1) *The " 1831 " 30-c.c. water-cooled engine, adapted to drive a cargo liner by W. A. Morris*

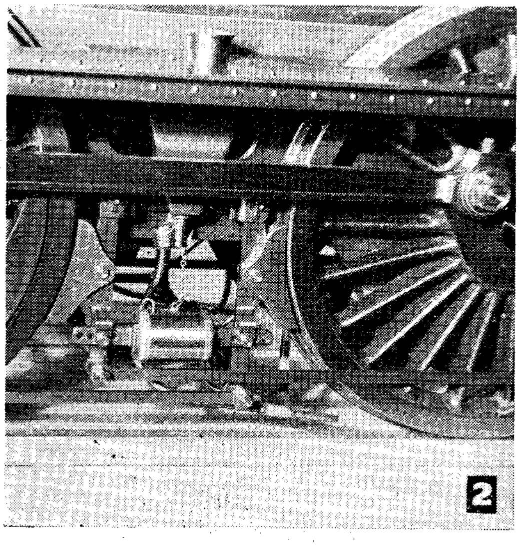
(2) *Sanding and brake gear of A. J. Webb's " Midland Compound " chassis*

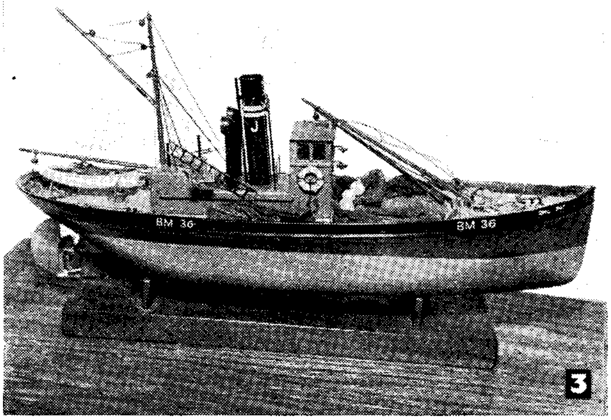
(3) *A well-detailed little steam drifter built to 4 mm. scale by A. T. Judd, of Birmingham*

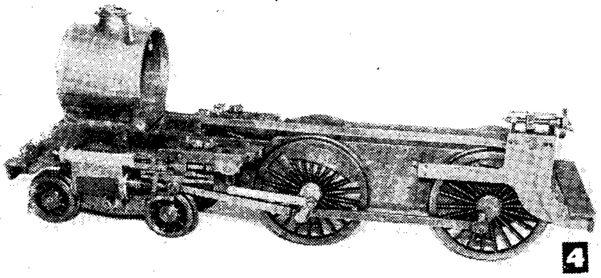
(4) *This " Schools " class locomotive, being built by a schoolboy, D. B. G. Merrick, will be dealt with in a subsequent article*

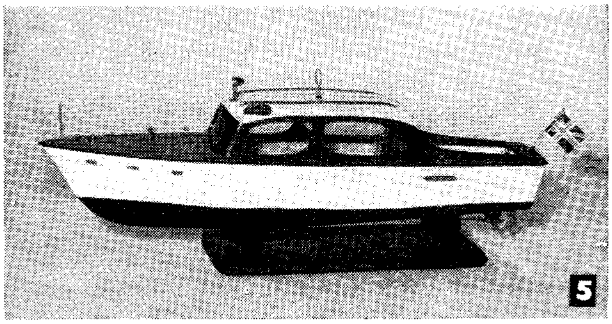
(5) *A nice little cabin-cruiser built by a junior, M. J. Lockley, of Birmingham*

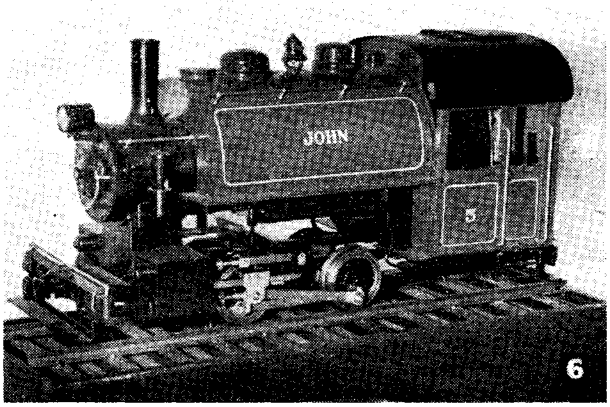
(6) *An attractive and nicely-built American industrial locomotive by H. Wilshaw*











at the top of the connecting rod, but the big end (also with split brasses) is of the marine type. Correct split brasses are fitted also to the main bearings.

In the valve-gear, the eccentric-rod works a rocking-shaft, from which vertical links or side-rods drive the valve cross-head. The guides fitted to this are not part of the original design, by the way, but were added by Mr. Stelfox, probably, as he says, unnecessarily.

The cross-arm governor, which operates a butterfly throttle-valve, is driven through the usual mitre-gears from a "follower" crank, on which a pin engages a hole in the main crank-pin. There is a neat wood-lagged stand-pipe, with screw-down stop-valve, to take steam to the valve-chest, and the water-pump is worked by a rod from the beam.

With a good finish throughout, the engine looked very elegant under power, and the (to many visitors) uncommon "grasshopper" action caused quite a bit of interested comment.

A type of steam-engine which is not modelled as frequently as it might be is the overtype semi-portable—the under-type, too, for that matter. Perhaps this is due to lack of information, but probably W. J. Hughes will be supplying some of that in his series of articles for steam-lovers.

However, at the Birmingham show, F. W. Wallis, of the home club, had an overtype engine, with a dynamo mounted on the same base-board. Obviously, the engine had been run, and allowing for that the finish generally was good, although one would prefer to see the copper lagging of smokebox, boiler and firebox painted and lined, as in the prototype. (In passing, there was a locomotive model finished all bright in stainless steel; it looked far too "pretty-pretty," in my opinion, and would benefit from a visit to the paint-shop too.)

The overtype engine was apparently free-lance, and it possessed one or two features which were rather surprising, in view of its general quality. For example, ordinary snap-lid cycle-type lubricators were used on the main bearings and on the slide-bars, and the cylinder-base was not high enough, since the motion fouled the chimney when the latter was hinged down into its crutch on the cylinder.

Again, there were round-headed slotted screws on the lifting-link, and another slotted head on the cross-head pin. Yet the builder had taken the trouble to make acorn-shaped blind lock-nuts for the caps of the main bearings!

The cylinder was mounted on a separate flat seating saddled to the boiler, which was gas-fired. Quite a nice representative model, which must have given Mr. Wallis many hours of pleasure in building and running.

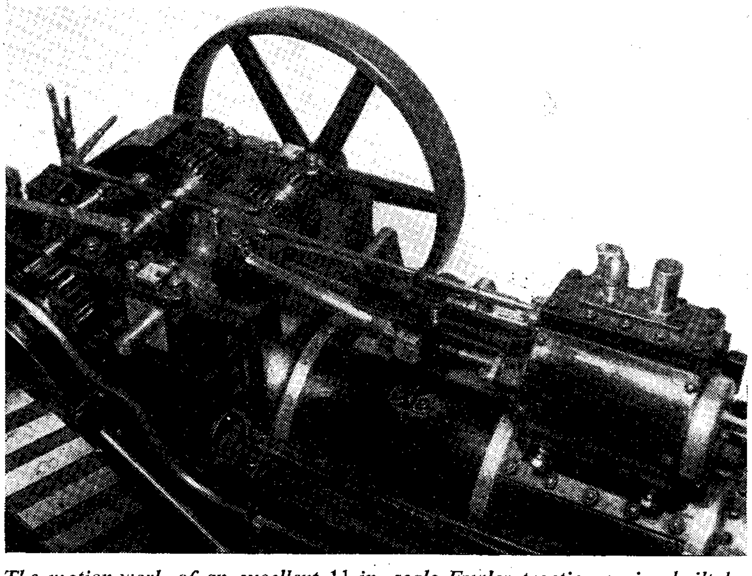
Traction Engines

One of the traction engines on view was a 3-in. scale free-lance engine built by two local members, L. E. Boll and W. E. Hammond. Complete with current Road Fund Licence and full-sized number-plates, it had been used in the streets of Birmingham to draw the attention of citizens to the show—*and* it had a police escort while doing so! Nothing like doing the thing in style!

Another 3-in. scale job was a Fowler showman's road locomotive, which, though incorrect in some detail—for example, the belly-tank was much too small—had a definite fairground atmosphere about it.

Another Fowler engine, by A. E. Phillips of Birmingham, was a single-cylinder agricultural type, with a pukka Fowler appearance. Finish was good on both paint and bright-work, allowing for the fact that the engine had obviously done some work, but the painting, which was all black, would have benefited considerably from the addition of some neat lining to relieve it. Contributing not a little to the correct prototype appearance were the pump, slide-bars and brackets, forked little end of the connecting-rod, the fairlead, and the draw-beam with its screwed taper cotters.

We also had the pleasure of seeing again the magnificent $1\frac{1}{2}$-in. scale Burrell, by A. L. G. Newman, of Oxford, which won a silver medal at the 1952 London Exhibition. The finish of this engine sets a standard which is not achieved by many, but which might well be the aim of all. I understand that 200 hours were spent on the painting alone.

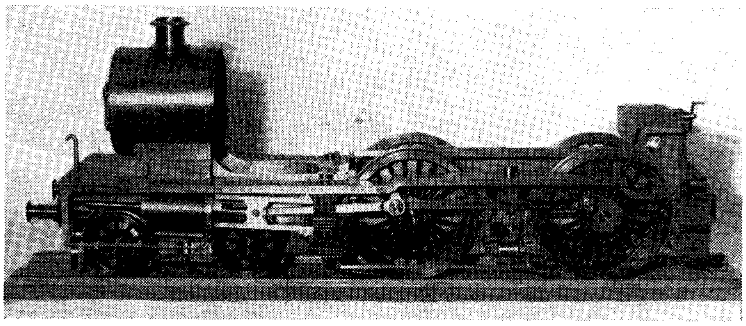


The motion-work of an excellent $1\frac{1}{4}$-in. scale Fowler traction engine built by A. E. Phillips, of Birmingham

Model Cars

Among the cars were several more-or-less orthodox racing types, but the ones which attracted me most were those exhibited by G. H Jenkins, who is not attached to any club. It is true that the models were nothing like so well-finished as they might have been, but they did give a good general impression of the automobile engineering of the first years of this century.

Included were a 1906 Wolseley, two Mercedes of 1904 and 1905 respectively, the chassis of the good old Model T (1914), and the 1903 Napier-Gordon Bennett and 1904 Rolls-Royce. Another of the cars was a *steam-driven* model of a Benz car, made in 1890-95, and sold as a toy for about 17s. 6d. Incidentally, it has often occurred to me that a model steam-car, correctly driven, would make an admirable subject for experiment among the fraternity, and I wonder if anyone has ever tackled the job? There were plenty of prototypes—it was a Stanley



The standard of craftsmanship and accuracy on this "Midland Compound" chassis was very high

steamer which first touched two miles a minute, and held that record for many years, of course.

Marine Models

The marine section of the exhibition was very strong, both in power-boats and "scenic" ship-models, and the Birmingham Ship Model Society were represented in strength, with many winners of premier awards at former London exhibitions, built by Clarke, Field, and Pariser. Such classic models set a standard of detail, accuracy, and finish which, as I have previously commented, might well be the target of us all.

But not all the really good marine models were from the Ship Model Society: there were the beautiful Admiralty steam pinnace *Gadfly* and the steam launch *Mayfly* made by the late D. Picknell, one of the founders of the Birmingham S.M.E.; there were boats from other members of the home society, and a good number from (among other clubs) the Bournville M.Y.P.B.C., including the well-known speedboat *Faro* British "A" class record-holder for so many years.

One of the Bournville boats was a cargo liner, about 5 ft. 3 in. long, which is being built by W. A. Morris. Most of the deck fitting has still to be done, but the vessel showed every sign of decent honest craftsmanship so far. The hull was nicely shaped, with twin screws, and much of the superstructure is in place.

The power unit was displayed outside the hull; it was a 30 c.c. watercooled twin petrol engine (the "1831" design), neatly mounted in a framing of duralumin, with a gear-box to drive the twin shafts. A centrifugal water-circulating pump is mounted on and driven from the gear-box, as is a plunger type bilge-pump: the former is geared up and the latter geared down.

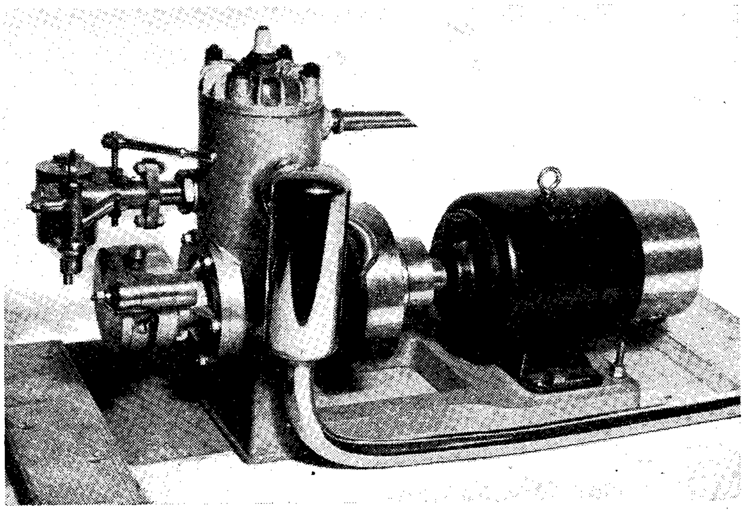
A rather ingenious starter mechanism is employed. A flexible wire cable, with suitable finger-grip handle, is wrapped round a drum fitted on a shaft which is in line with, but separate from, the end of the crankshaft. Mounted on the same shaft is what appears to be a centrifugal governor, (but isn't), and the inner end of the shaft has a transverse pin capable of being engaged with dogs mounted on the crankshaft. When the cable is pulled, the weights of the "governor" fly out, which slides the starting shaft through the bearing and drum so that the dogs engage; the remaining pull on the cable thus rotates the crankshaft. When tension is released, light springs return both the shaft and the drum to their normal positions.

Two cabin-cruisers were shown by father and son, H. Lockley and M. J. Lockley respectively. That of Mr. Lockley's was to 1-in. scale, and the catalogue said it was to a Samuel White design. However, I presume it was built from a photograph or photographs; certainly not from correct drawings. The forefoot of the hull was far too spoon-shaped, without any trace of sharpness, and I imagine that in a cross-breeze the boat will drift sideways at an alarming rate. Finish was reasonably good, allowing for several years' wear and tear, but once more we had large-headed screws used to secure the deck and the deck-fittings. As was pointed out in my Northern Models report, this is an entirely unnecessary and undesirable practice; however good a model is, these slotted screws immediately bring in a "toy-shop" flavour.

Master Lockley's boat was a neat little cabin cruiser with a nicely shaped hull, perhaps 15 in. long. The painting could have been smoother, but still it was better than some we have seen by older men. And again there were the large screws holding down the deck! The boat was electrically driven, with a neat little switch on the fore-deck, disguised as a cable cleat.

Junior Work

As at Manchester, there were quite a number of exhibits by junior craftsmen, one of which we have just noticed. Others included a *Tich* 0-4-0 locomotive by J. A. Hawtin, who is 13 years old. There was not much done, but what there was showed promise. Another locomotive chassis, with considerable work in it, was a Southern "Schools" class 4-4-0 by D. B. G. Merrick, of Oxford. This young man had had courage in tackling a $3\frac{1}{2}$-in. gauge



This well-finished 30-c.c. petrol-generator set was built by W. N. Thatcher, of Oxford

locomotive with three cylinders and three sets of valve gear. The finish generally was not too bad, but could be appreciably better on the bright-work. In several places round-headed screws were to be seen, but doubtless these will be correctly replaced in final assembly. Incidentally, the mechanical fitting of the various parts appeared to be good—not too tight and yet without sloppiness—and there had been a bit of nice screw-cutting on the square-threaded reversing-screw.

Another boat was the 7/12-in. scale M.T.B. by D. H. Williams, junior, of Birmingham. The hull was completed and the deck laid in separate planks, quite neatly fitted. A start had been made on the bridge, but this appeared to be rather on the small side for the depth and beam of the hull.

Probably the cream of the junior work, however, was the $2\frac{1}{2}$-in. centres back-geared lathe which is being built by J. Harbidge, junior, of Marston Green. This is a fine effort indeed for a youth of 16, and it should serve him well when complete. The headstock and tailstock are built up from mild steel, the phospor-bronze mandrel bearings being clamped in split blocks. Two lengths of round bar compose the bed, and the slides of the cross-slide are round-bar also. The lead-screw is placed centrally in the "bed," and the cross-feed screw has an adjustable indexing collar.

Among the i.c. engines was a neat petrol driven generator set, with a 30 c.c. two-stroke engine. This was water-cooled, probably made from commercial castings, with a carburettor fabricated from brass. It was carried on a neat, cast cradle which also incorporated the dynamo platform. (See photo on page 671.)

Many of E. T. Westbury's well-tried designs were represented on this stand, of course; they included the 5 c.c. "Kestrel," the 10 c.c. "Ensign" two-stroke, the 30 c.c. o.h.v. "Kittiwake," the 30 c.c. twin "1831" engine, and the 15 c.c. "Seal" four cylinder. On the whole, the workmanship of the i.c. engines was quite good, and I shall be illustrating some of them in a separate article, all being well. The same applies to other sections of the show, too; this is a preliminary sketch only, and I hope to deal with the various sections more fully in subsequent articles. Even then, as previously stated, many fine models will have to be omitted, for several complete issues of THE MODEL ENGINEER would be required to deal adequately with this magnificent show!

A SIMPLE DARKROOM CLOCK

By D. Birchon

SO much interest in photography has been apparent in THE MODEL ENGINEER recently, that I venture to submit a description of a darkroom clock which I have used for some six years or so. It can easily be made from an old alarm clock in one evening.

Fig. 1 shows the "works" of mine, and it will be seen that fourteen of the the fifteen teeth on the escapement wheel have been filed off! This results in the clock going at fifteen times its normal speed, so that one revolution of the minute hand corresponds to four minutes, and one revolution of the hour hand to 48 minutes. Fig. 2 shows the new dial of the clock marked out in indian ink. The outer ring shows minutes and seconds, and the inner ring is marked in minutes.

As may be imagined, the clock now has a loud and distinctive "tick," which I use for timing exposures during photography and especially during enlarging, as this leaves my eyes free for any "dodging in" operations required. The alarm mechanism is, of course, most suitable for timing the tank development of plates or films.

The mechanism of the clock which I adapted was so badly worn, that I had to build up the solitary escapement tooth with solder, and file it back to the correct profile. Rather to my surprise, this composite tooth still functions perfectly.

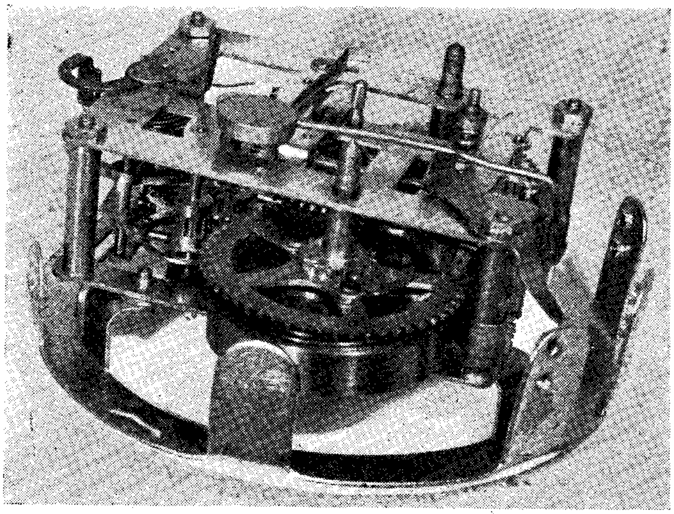


Fig. 1. The clock motion, showing the modified escapement wheel

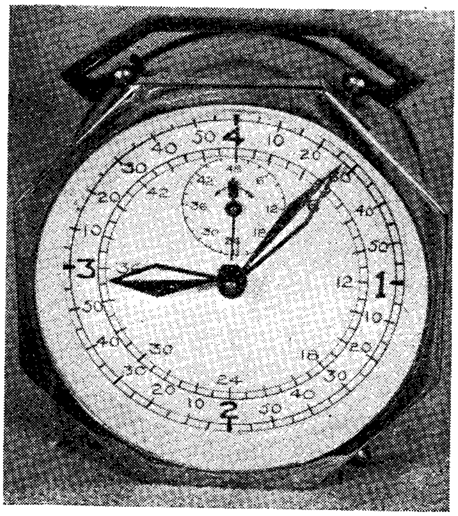
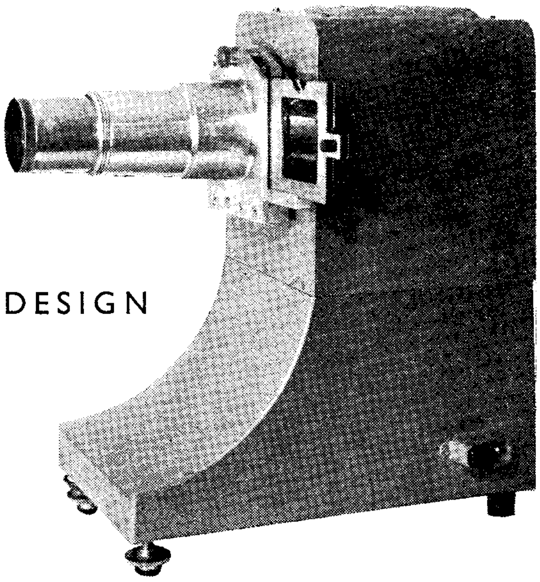


Fig. 2. The finished clock and its new dial

A miniature slide projector



TO THE "MODEL ENGINEER" DESIGN

By W. L. Rowson

THE slide projector illustrated here is built to "Kinemette's" design published in THE MODEL ENGINEER during 1950. It takes the standard 2 in. × 2 in. slide. The picture area, therefore, covers the popular 1 in. × $1\frac{1}{2}$ in. Leica frame or the $1\frac{1}{4}$ in. × $1\frac{1}{4}$ in. Purma size. These sizes are about the maximum the condenser lenses will cover, which are 2 in. diameter. Difficulty occurred in obtaining the $2\frac{1}{4}$ in. lenses specified in the design. The 2 in. ones have proved perfectly satisfactory. Two objective lenses are available, a 3 in. Leech and a 4 in. Dallmeyer, both in 42 mm. mounts.

The lamp fitted is a standard projection bulb with pre-focus cap, 12 V 100 W, run from a transformer in the base and fed from the mains, covering 200 to 250 V in steps of 10. A $2\frac{1}{2}$ in. semi-spherical silvered mirror is fitted as a reflector. The lighting equipment was only decided on after lengthy experiments with various lamps, including motor-car head-lamp bulbs, the chief trouble with these was premature blackening of the glass if over-run, with consequent progressive loss of brilliance of the projected image. An adequately brilliant picture 60 in. ×40 in. is given with this power, and a correctly exposed Kodachrome transparency.

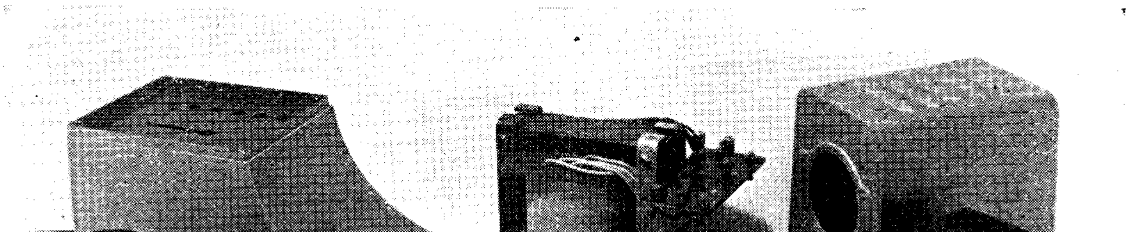
Castings in aluminium are used for the condenser housing, objective housing and lamp-house front. The base is fabricated from sheet aluminium exactly as in THE MODEL ENGINEER design. The projector is finished in grey mottle cellulose (five thin coats, including the correct undercoating) put on with a Reeves "M.E." spray gun.

The second picture shows all the "bits and pieces" before final assembly.

Top Row
Main base, transformer and outer lamp-house.

Middle Row
3 in. lens, reflector, 4 in. lens, condenser spacer, lamp-holder, condenser retaining ring, condenser and objective housing assembly, lamp-house door and lamp-house inner lining.

Bottom Row
Complete slide carrier, front feet, reflector supports, condenser-objective housing retainers, condenser lenses, front feet and various small screws.



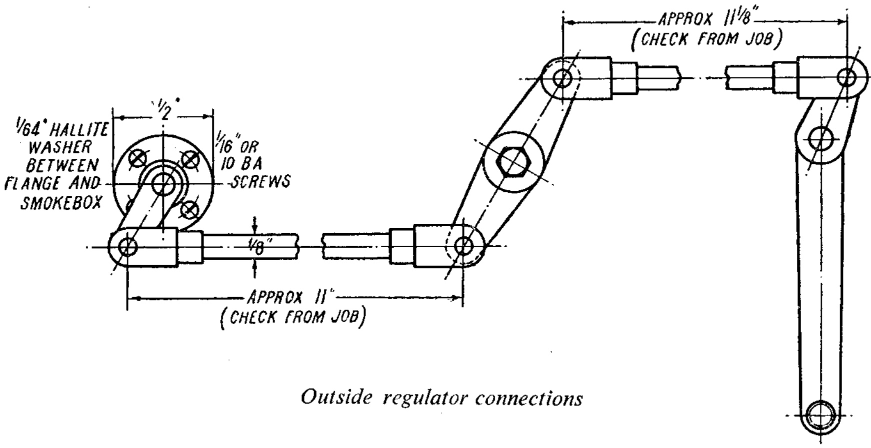
L.B.S.C.'s "Britannia" in $3\frac{1}{2}$ in. Gauge

● OUTSIDE REGULATOR-RODS

BUILDERS using the poppet-valve regulator, can now make the intermediate lever and connect up the outside rods. Here, I have made a little variation from full size, inasmuch as the full-sized intermediate lever is a one-piece job with both arms in the same plane, whilst I am specifying an offset one, as you see. The arm on the regulator spindle projects proportionately more from the smokebox, than in full-size, the feed pipes are bigger, and there are other items which prevent a one-piece intermediate lever being used without undue offset of the rods; and, anyway, the lever shown, gives a better bearing on the stud. Both upper and lower arms are identical, and can be sawn and filed from 3/32 in. steel; drill the holes in the larger end 7/32 in. or No. 3. Chuck a bit of $\frac{5}{16}$ in. round steel in the three-jaw, face the end, centre, and drill down No. 23 for about $\frac{3}{8}$ in. depth. Turn down 3/32 in. of the end to a tight fit in the hole in the arm; part off at $\frac{5}{16}$ in. from the end. Reverse in chuck, turn another 3/32-in. pip on the other end, squeeze the arms on, setting them exactly opposite, braze the joints, clean up, and poke a 5/32-in. parallel reamer through the hole.

Chuck a piece of 5/32-in. round steel in three-jaw, face off, turn down a full $\frac{1}{8}$ in. of the end to $\frac{1}{8}$ in. diameter, and screw $\frac{1}{8}$ in. or 5 B.A. Part off at a full $\frac{5}{16}$ in. from the end. Reverse in chuck, centre, drill No. 48 and tap 3/32 in. or 7 B.A. Drill and tap the boiler boss to suit the stud, screw home, mount the lever on it, and secure with a commercial screw and washer as shown. The lever should move easily without being slack, and should have just the weeniest bit of end play. Next make four forks, as per the drawing given recently along with the handle; three as shown, but the fourth need only be $\frac{3}{16}$ in. wide, to match up better with the little arm on the regulator spindle. The rods connecting the forks are made from $\frac{1}{8}$-in. round steel, screwed at both ends to match the forks. The exact lengths of rods are best obtained from the actual job. When the regulator handle is vertical, as shown, the regulator valve should be shut, and the levers in the position illustrated. Pulling the handle, gives a corresponding movement to the regulator arm, and lifts the valves off their seatings. For pins, use bits of 3/32-in. silver-steel, reduced at the ends to $\frac{1}{16}$ in. and furnished with $\frac{1}{16}$ in. or 10 B.A. nuts, for neatness' sake. Even these would be 1-in. nuts in full size; and they don't use 1-in. nuts on the big engines' regulator rod pins!

Before finally connecting up, take precautions against air leaking into the smokebox at the place where the spindle bearing comes through.

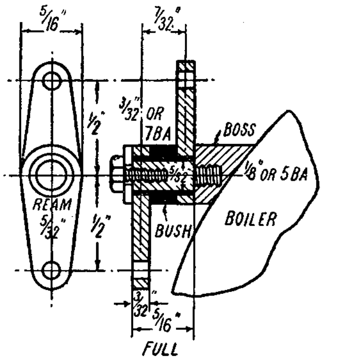


Outside regulator connections

Cut a 1/64-in. Hallite washer $\frac{1}{2}$ in. diameter, with a hole in it, a close fit on the spindle. Also cut a flange or disc the same size, from 20 or 22-gauge sheet brass, with a hole in the middle for the spindle, and four No. 51 holes for screws. Bed the Hallite washer tightly on the smokebox, put the metal washer over it, and secure with four $\frac{1}{16}$-in. or 10-B.A. round-head screws as shown.

Combined Blast and Blower Nozzle

On the full-sized engine, the blower consists of four small jets arranged around the blast nozzle; so the gadget shown, should delight Inspector Meticulous. It is similar to those specified for *Doris* and *Pamela*. Castings may be available; but if not, chuck a stub of $\frac{7}{8}$-in. round rod in three-jaw, face the end, centre, and drill down about $\frac{5}{8}$ in. depth with 5/32-in. drill. Turn

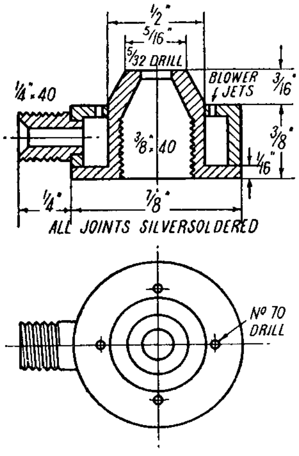


Intermediate lever

down $\frac{1}{2}$ in. length to $\frac{1}{2}$ in. diameter, and taper off the end as shown, for a bare $\frac{3}{16}$ in. down. Part off to leave a $\frac{1}{16}$ in. full diameter flange. Reverse in chuck, open up with 11/32-in. drill almost to the end; leave only about $\frac{1}{16}$ in. of the 5/32-in. hole, which will allow the

exhaust to shoot out like nobody's business, without causing back pressure. Tap $\frac{3}{8}$ in. $\times$ 40, to suit the blastpipe.

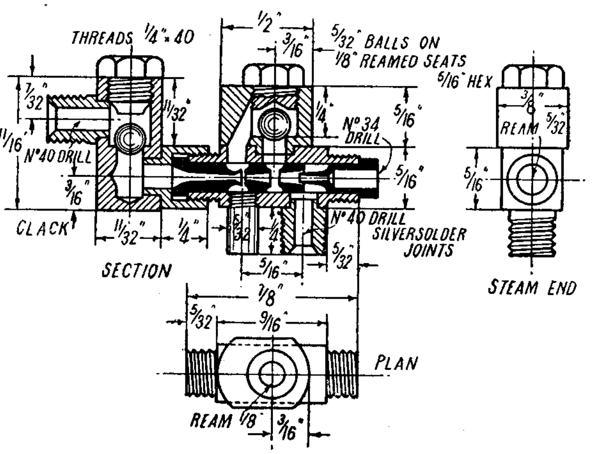
Chuck the $\frac{7}{8}$-in. rod again, centre, and drill down $\frac{7}{16}$ in. for about $\frac{3}{8}$ in. depth; then, with a $\frac{3}{4}$-in. D-bit, or flat-ended boring tool, form a recess $\frac{3}{4}$ in. diameter and $\frac{1}{4}$ in. deep. Part off at $\frac{5}{16}$ in. from the end. Reverse in chuck, and bore out the $\frac{7}{16}$ in. hole until it is a close fit on the $\frac{1}{2}$ in. part of the nozzle; see section. On top of the cup, and close to the $\frac{1}{2}$ in. hole, drill four No. 70 holes in the form of a square, as shown in the plan view, for the blower jets; the big engines have four teats, screwed into holes in the annular cavity, but these are



Blastpipe nozzle

not needed in $3\frac{1}{2}$-in. gauge size. In the side of the cup, drill a $\frac{3}{16}$-in. hole; and in it, fit a $\frac{1}{4}$ in. $\times$ 40 union screw, as shown. Put the cup over the centre piece, as shown in the section, and silver-solder it in position; both top and bottom joints, and the union screw, can be done at the one go. Pickle, wash, and clean up; if any of the tiny holes are stuffed up with silver-solder, poke the drill in again. On these small jobs, it pays in more ways than one, to be frugal with the silver-solder—it costs muckle bawbees the noo, ye ken!—as very little is required to seal a close-fitting joint. I use it in wire form, and get exceptionally neat joints. The other day I made a weeny brass L.B. & S.C.R.-type driver's torch-lamp, only $\frac{1}{2}$ in. high, and sent it to my good friend the editor of the *Locomotive Express*, as a leg-pull over something he had written me. The joints were all silver-soldered, but you couldn't see a trace of it at the side handle, wick-spout, or loops for the wire handle by which we hung the lamps on the motion when oiling up, or doing other jobs. It lit up and burned O.K., and caused much amusement in the editorial office; the sub-editor is waiting a chance to "commandeer" it!

Screw the completed blastpipe nozzle on to the top of the blastpipe, and connect the union screw at the side, to the thoroughfare nipple on the smokebox tubeplate, with a piece of $\frac{1}{8}$-in. copper pipe furnished with nuts and cones at both ends. To adjust the nozzle for best blast effect, just put a straight piece of 5/32-in. rod (silver-steel is usually



Injector and clack

straight enough) down the chimney into the nozzle. If the rod doesn't stand straight up in the middle of the chimney, bend the blastpipe carefully until it does.

Injector

In the original drawings sent to me by Mr. Riddles, before the frames of the first of the full-sized engines were laid down, a Gresham-and-Craven vertical injector was shown, and that was why I showed one, which I schemed out specially for the job, on my original general-arrangement drawing. However, while the engine was in course of erection, some injector experiments were undertaken, and it was found that the G.W.R. injectors, made at Swindon, gave the best results for the job in hand. Therefore, when *Britannia* herself was finished, she carried two Swindon-made horizontal "squirts" in place of the vertical type; and that is why I now specify my own horizontal "standard" injector. I altered my original general-arrangement drawing to show this, at the same time that I put in the amended valve-gear brackets. The original drawings mentioned above, showed the expansion link working in plummer-block bearings, supported by a different type of frame altogether, to that finally adopted.

I have made small improvements in these injectors from time to time, to increase efficiency, reduce steam consumption, and minimise loss of boiler pressure when the injector is working. Being only a human being with all the faults and failings of the species, I like to keep a few things "up my sleeve," in case anybody starts what our transatlantic cousins call "getting sassy." One thing I found, is that the fully-reversed-taper steam cone, with a fairly wide nozzle, gives lower steam consumption and a quicker pick-up, so this is shown in the accompanying sections. Also, a positive locating spigot for the ball chamber. The method of construction has been fully detailed in these notes, also in the *Live Steam* and *Maisie* books; so if I just give a brief outline of the job, for beginners' and new readers' benefit, it should suffice.

Built-up Injector Body

A casting can be used for the injector body, but it can be built up as easily as machining the casting, and this is how. Part off a piece of $\frac{5}{16}$-in. square brass rod in four-jaw, to a length of $\frac{7}{8}$ in. Chuck truly, centre, drill through No. 24 and ream

5/32 in. Turn down 5/32 in. length to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Reverse in chuck, and turn and screw the other end likewise. If you slack and retighten the same two jaws, the rod will run truly for second end. Drill a $\frac{1}{8}$-in. hole in the middle of one facet; and $\frac{3}{16}$ in. away, drill a No. 40 hole. On the facet opposite, drill two No. 30 holes at $\frac{5}{16}$ in. centres. Tap the one opposite the No. 40 hole, 5/32 in. × 40. Open out the other with 5/32-in. drill, and make a $\frac{1}{4}$ in. × 40 nipple to fit it, but don't squeeze it in until the ball chamber is fitted. Counterbore the $\frac{1}{8}$-in. hole in the other facet, for a bare $\frac{1}{16}$ in. depth, with a $\frac{3}{16}$-in. pin drill.

For the ball chamber, or air release valve, part off a $\frac{3}{8}$-in. length of $\frac{1}{2}$-in. round brass rod. At $\frac{1}{16}$ in. from the true centre (indicated by tool marks) make a centre-pop. Chuck in four-jaw with this running truly; open with centre-drill, drill right through with No. 34 drill, open out and bottom to $\frac{1}{4}$ in. depth with 7/32-in. drill and D bit, tap $\frac{1}{4}$ in. × 40, and take a facing skim off the end. Put a $\frac{1}{8}$-in. parallel reamer through the remains of the No. 34 hole. Screw this on to a stub mandrel held in three-jaw (bit of rod with a $\frac{1}{4}$-in. × 40 screwed pip turned on the end) and cut back the bottom of the chamber, to leave a spigot which will fit tightly in the counterbore on the injector body. This is shown in the section. Then, at $\frac{3}{16}$ in. from the centre of the reamed hole, in the widest part between the hole and the outside, drill a No. 40 hole, on the slant, into the ball chamber; and mind you don't spoil the ball seat!

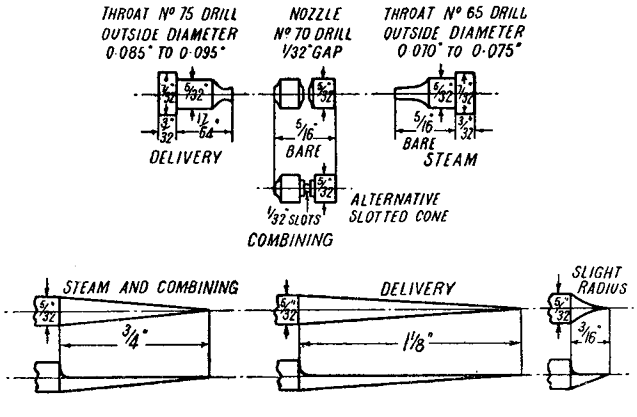
Press the spigot into the counterbore on the injector body, with the two No. 40 holes coinciding; squeeze in the union screw, and silver-solder both at one heat, only using enough silver-solder to sweat through the joints. Pickle, wash and clean up; put the 5/32-in. parallel reamer through the bore again to remove any burrs, and fit a ball and cap to the ball chamber, same as you would fit the delivery valve to a pump. The ball should have a bare $\frac{1}{16}$ in. total lift. If the cap is countersunk, the ball always falls back on its seat. File or mill a flat on each side of the ball chamber; see plan.

Cones

Judging from my correspondence, the cones are the *pons asinorum* of about 90 per cent. of injector makers, and yet they needn't be. If they are made to the given sizes, and spaced as shown or indicated, the injector will work. I've examined scores of injectors made by readers who swore by all that was holy, that the cones were made to instructions; but not one of them was anywhere near it! I have always done my best to explain the faults, and in many cases have replaced cones, to the maker's delight and satisfaction, though in one case I was rewarded by a "sarky" letter when I explained that the failure of the injector was due to bad workmanship. I'll say it was—and needless to add, *that* merchant didn't get any new cones!

First make the three reamers shown. Simply turn the tapers on pieces of 5/32-in. silver-steel, making the shanks whatever length you fancy; file away half the diameter, harden and temper to dark yellow, and rub the flats on an oilstone. To get the press fit O.K. on the combining cone, put a taper broach in the steam end of the injector body (the end with the union) and take out a scraping. Chuck a piece of $\frac{3}{16}$-in. round rod in three-jaw, and turn about $\frac{3}{8}$ in. length, to a diameter that will just enter the broached end of the body. Face, centre, and drill to a full $\frac{5}{16}$ in. depth with No. 71 drill. Easier said than done, says beginners and raw recruits. Not at all—*everything* is easy *when you know how*! Don't use a regular centre-drill for the start; turn a little cone point on a bit of $\frac{1}{8}$-in. silver-steel, file it square, and harden and temper to dark yellow. That makes a swell centre-drill for drills below 60 or so. You only want a centre deep enough to give the drill a true start. I make my centre-drills from broken-off dental burrs; just rub the broken end on an oilstone, to point and square it. No hardening or tempering needed. Hold your drill in a little pin-chuck (our advertisers sell them) and put the pin-chuck in the tailstock chuck. Feed the drill in, $\frac{1}{16}$ in. at a time, withdraw, flick the chips off it, and ditto repeato. I use a lever tailstock, and by working the handle like a pump, it is easy to put even a No. 80 drill into the full depth of the flutes, without breaking it. The cause of breakage, in 99 cases out of every 100, is choking of the flutes by chips, causing the drill to seize up.

After drilling, turn a blunt nose on the end—exact diameter doesn't matter, but best results are obtained when it is about twice the diameter of the hole—and part off at $\frac{5}{16}$ in. from the end. Reverse in chuck, and ream the hole taper, with the $\frac{3}{4}$ in. long taper reamer in the tailstock chuck. Don't put it in too far; I use a brass bush, with a set-screw on the reamer shank, to act as a stop. The point should just come through, and if you put a No. 70 drill in, it should just be showing inside the hole. Slightly countersink the end, with the stubby reamer, and face off any burr. Pull the reamed cone barely half-way out of the chuck, and saw across with a jeweller's or other fine hacksaw; then face off the saw-marks on both halves and cut back slightly, as shown. Take the sharp edge off the entrance to the smaller half, with the stubby reamer, then press it into the body, using vice as press (shown in *Maisie* book) and a bit of 5/32-in. rod with a countersink in the end, for a "pusher." Press as far as shown



Cones and reamers

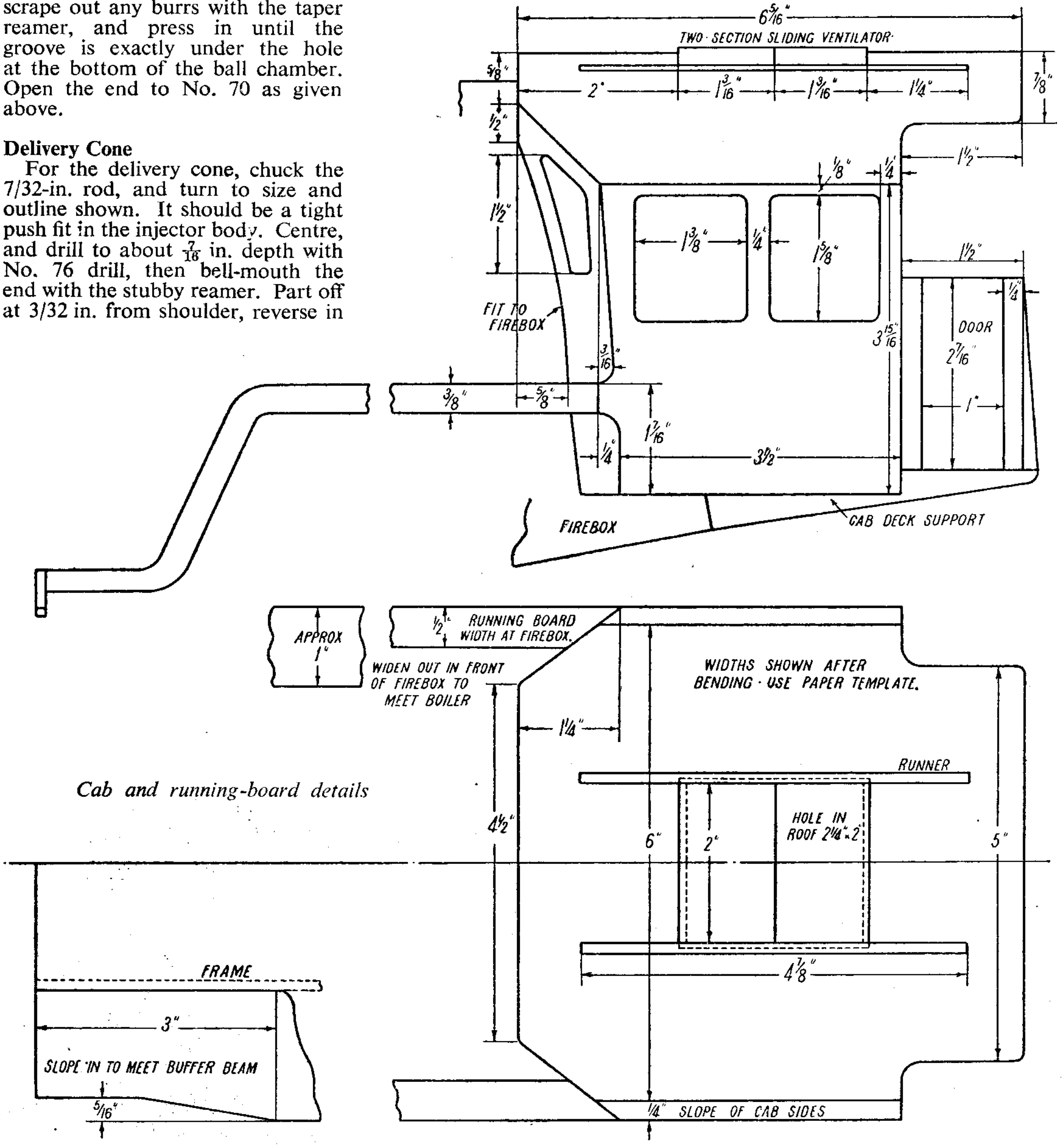
in the section, sighting it down the air-ball hole. Then put a sliver of brass, 1/32 in. thick, down the hole, and press in the second half of the cone until it touches the sliver. Simple enough ! Put the $\frac{3}{4}$-in. taper reamer in by hand, twisting it two or three turns with a tap-wrench, and finally, put the No. 70 drill through the tip, by twirling it (held in a pin-chuck) between finger and thumb.

If the slotted cone is used, turn a $\frac{1}{16}$-in. groove in the middle file a couple of 1/32-in. slots across it, scrape out any burrs with the taper reamer, and press in until the groove is exactly under the hole at the bottom of the ball chamber. Open the end to No. 70 as given above.

Delivery Cone

For the delivery cone, chuck the 7/32-in. rod, and turn to size and outline shown. It should be a tight push fit in the injector body. Centre, and drill to about $\frac{7}{16}$ in. depth with No. 76 drill, then bell-mouth the end with the stubby reamer. Part off at 3/32 in. from shoulder, reverse in chuck, and enter the longer tapered reamer until the point just comes through into the bell mouth. Bell out the flange end with the stubby reamer as shown in section ; then put a No. 75 drill in the pin-chuck, and put it through the throat by twirling between finger and thumb as above. When the cone is right home in the injector body, it should be about 1/64 in. away from the nozzle of the combining cone.

To make the steam cone, chuck the 7/32-in. rod again, and turn to given size and outline. Centre the end, and drill about $\frac{7}{16}$ in. deep with No. 67 drill ; then ream almost to a knife edge, with the $\frac{3}{4}$-in. taper reamer. Part off at 3/32 in. from shoulder, reverse in chuck, and drill the opposite end to a bare $\frac{1}{4}$ in. depth with No. 34 drill. Open out the throat by hand, with No. 65 drill. When inserted, the nozzle should



Cab and running-board details

enter into the combining cone just 1/32 in. The annular space between the nozzle and the combining cone must be big enough to allow sufficient water to pass. Put your finger over the end of the injector body, and blow into the water union ; then put the steam cone in, put your finger over the end of that, and blow again. If there isn't much difference in the amount of air you can blow through the union, the clearance is O.K. but if when you put the cone in, there is considerable difference, or hardly any air at all can pass, poke the stubby reamer into the end of the combining cone, and bell it out a little more.

Delivery Clack

The body of the delivery clack is an $\frac{11}{16}$-in. length of $\frac{5}{16}$-in. or 11/32-in. rod. Chuck in three-jaw, and form a ball seating, same as that in the ball chamber, but about 11/32 in. deep, leaving the hole blind at the bottom, as shown in the section. At 7/32 in. from the top, and $\frac{3}{16}$ in. from the bottom, drill $\frac{3}{16}$-in. holes diametrically opposite, the top one piercing the ball housing, and the bottom one entering the hole under the ball seating. Fit a $\frac{1}{4}$-in. × 40 union screw in the upper one ; in the lower, fit a tapped socket, as shown, made from $\frac{5}{16}$-in. round brass rod. Drill the socket 7/32 in., and bottom it with a D-bit, same as a seating for a valve ball, see section ; the depth should be a full $\frac{3}{16}$ in. Silver-solder both union screw and socket, and fit a 5/32-in. valve ball and screwed cap. The lift of the ball should be a bare $\frac{1}{16}$ in., as an injector clack stays up all the time, instead of bobbing up and down like a pump clack.

Screw the clack on to the delivery end of the injector. If it doesn't stand up straight when the inner end of the socket is hard up against the flange of the delivery cone, skim a shade off the flange, until it does. The two flat faces should make water-tight contact. Screw a $\frac{1}{4}$-in. length of 5/32-in. copper tube into the overflow hole ; or you can use a bend if desired, to squirt the overflow when starting, away from the rails. As the complete gadget only weighs 1 oz. or so, the pipes provide all the support it needs. The pipes cannot yet be fitted, as the delivery pipe goes along under the left-hand running-board, so the next job will be to fit the running-boards and the cab.

Cab and Running-boards

The cab is going to try the patience of those builders who hate sheet-metal working ; I'm not particularly in love with the job myself ! The sides slope towards the firebox, the front sheet being cut to suit ; and in addition, the side sections of the front sheet are set at an angle to firebox, one of the ideas being to avoid reflected glare from the windows into the enginemen's faces at night. The overall dimensions of the cab front were given in the illustration of the backhead with the fittings on it ; and some more detail measurements are given in the accompanying drawings. The way your humble servant finds best, is to cut out a paper pattern, or template, from stiff paper or thin cardboard, and fit it to the outline of the firebox wrapper. The part over the top of the wrapper is at right-angles to the centre-line of the engine; the sides bend backwards, as shown in the plan. The complete front may be all in one piece, bent as shown, or it may be in three separate pieces, with butt strips at the bends. When the dummy front is found to fit perfectly, it is used as a template to mark out the metal front. Sheet brass of about 22 gauge is suitable material, but steel may be used if preferred, for the whole of the cab.

The sides are a simple job to cut, all dimensions being shown ; go ahead and make them, and the next instalment will deal with assembly and erection, all being well.

FOR THE BOOKSHELF

Children's Toys Throughout the Ages, by Leslie Daiken. (London : B. T. Batsford Ltd.) 206 pages, size 6 in. by $9\frac{1}{2}$ in. Plates in colour ; illustrations in half-tone and line. Price 25s. net.

Who is there amongst us who, does not recall, sometimes with a pang of regret, the toys that gave us so much unalloyed pleasure when we were children ? Can there be many of us who, in later years, have not experienced a desire to learn more about those toys, their history and their significance ? Here is a book that must surely satisfy anyone, young or old, who has ever taken an interest in toys. Written by an obvious enthusiast who possesses an extraordinarily wide knowledge of his subject, and has spared no pains in research and the quest for information, the book deals with every known kind of toy from the earliest times to the present day.

The fascination of the subject is enhanced by a lucid style of writing and masterly treatment. The illustrations present an astonishing variety of toys of all nations and are certain to arouse memories in the minds of readers everywhere.

Some of the toys here illustrated and described were extremely ingenious ; and, although there have been some toys that were notable for their expensive and elaborate nature, it is clear that the main essential of most toys is simplicity. And so they have generally been all through the ages. When preparing a book of this nature, one of the main problems is to decide what to omit ; but we must confess to some surprise at the omission of any reference to a variety of tin trains of French, German and Japanese origin, which were very popular about 1895 to 1905. These were well—perhaps *too* well—made ; but they gave unadulterated pleasure to many small boys of the period, and some of them were to be seen in almost any toyshop worthy of the name. Apart from this omission, however, this book is a delight, and is to be strongly commended to a very wide circle of readers.

Layout Plans, No. 1. (Published by *The Railway Modeller*, Pecoway, Station Road, Seaton, Devon.) 20 pages, size $5\frac{1}{2}$ in. × 8 in. Price 1s. 3d.

We have received a copy of this interesting brochure which contains reproductions of about two dozen plans for model railways. It should be of considerable use to any of our readers who may be endeavouring to decide upon a suitable layout to fit an available space. Most of the plans in this little book present ideas that could be easily modified for adapting to odd-shaped spaces. Some of the simpler plans could be applied to ground-level outdoor tracks where a neat, simple but railwaylike station layout is desired in the larger scales. We commend this little book to the attention of any MODEL ENGINEER readers interested in model railway planning.

Talking about Steam—

NO. 18. FITTINGS FOR THE FOWLER "BIG LION"

By W. J. HUGHES

IN the years since steam road locomotion first came into its own, it is natural that the development of points of design would vary with the ideas of different designers and different firms. New ideas would be tried out, some to be discarded and some to be incorporated in future design, even though the basic elements of the machine remained the same. Thus the road locomotive built in the 1930s would contain refinements which were not possessed by its counterpart of the early part of the century.

As I have remarked before, it does not pay to be too dogmatic where traction engines and road locomotives are concerned. Not only did builders alter their ideas and details, from time to time, but additions or alterations were frequently made by owners themselves, to suit their own ideas. Again, an engine might be damaged in an accident, and if repairs were carried out either by the owner, or at a local works, which was often the case, the finished job might vary from the original one.

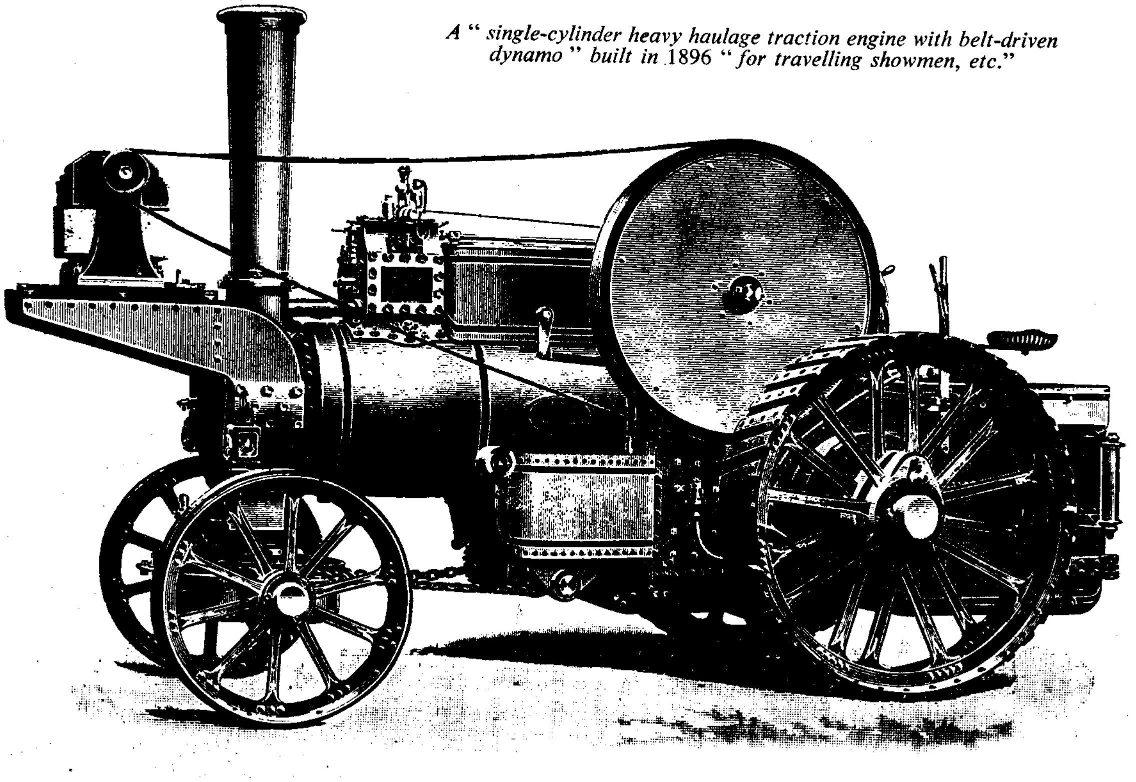
Moreover, alterations were sometimes made by the process which during recent years has been known as "cannibalising," where parts from an engine due to be scrapped were used in the repair of another one. Nor did this always apply to engines of the same make; I have a photograph of a Marshall fitted with a Fowler chimney, and a Fowler with Burrell canopy and chimney, while one steam roller—a real hybrid !—has Burrell cylinder block on Fowler boiler, with other parts from other makes thrown in for good measure. Hence the need for caution in modelling from a local prototype, where such alterations might easily lead one into error.

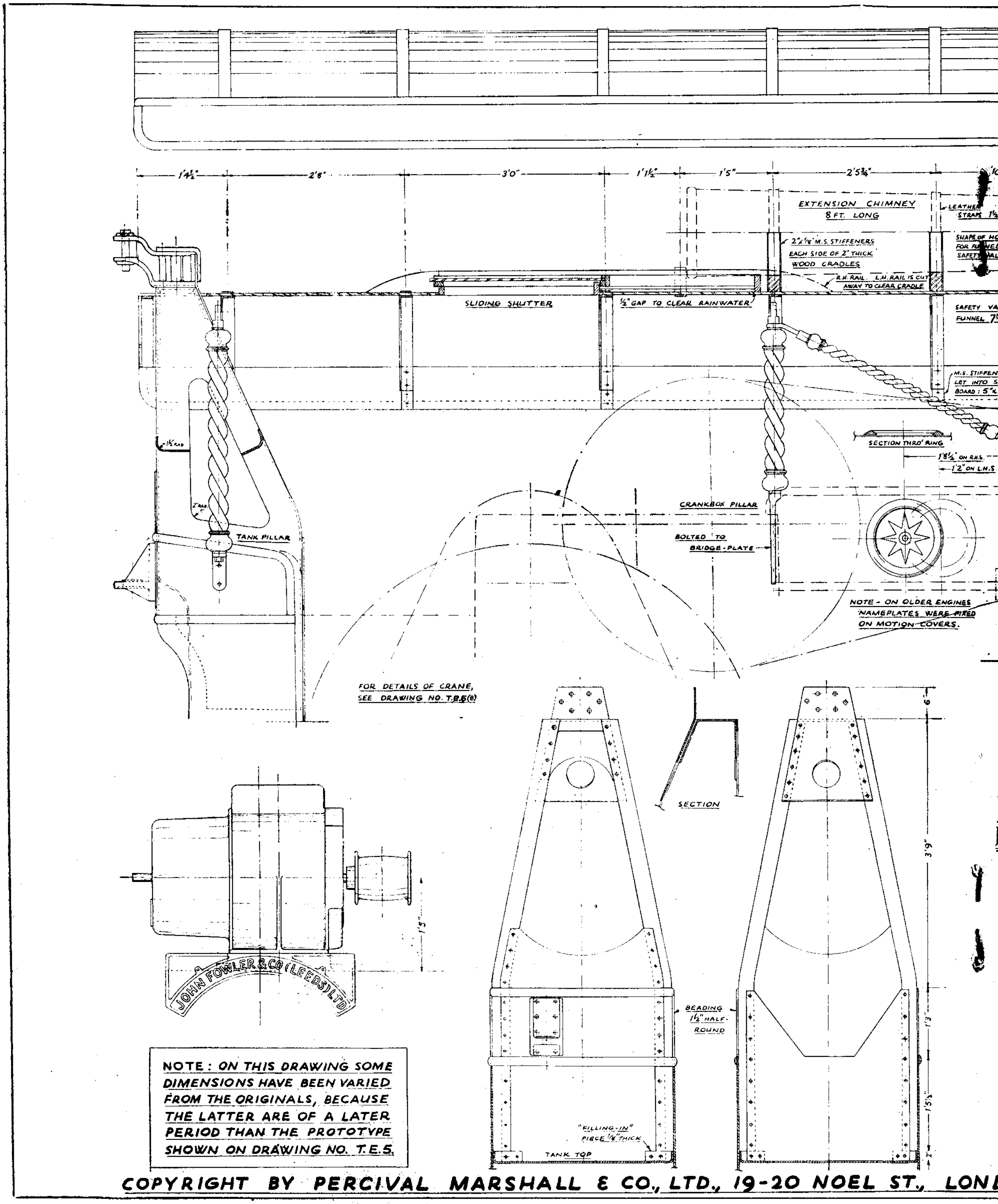
As an example of early design for a showman's engine, I am reproducing an engine from an engraving in the Fowler catalogue of 1896 loaned to me by Mr. A. R. Dibben of Timperley, Cheshire. (Readers may recall that an engraving of a compound road locomotive, copied from the same catalogue, was given in THE MODEL ENGINEER dated October 16th, 1952.)

The engine now shown is not actually a road locomotive, but a "heavy haulage traction-engine"—the differences being chiefly that the latter had smaller boiler and wheels than the former, and were not quite so strongly built. At the same time, the "heavy haulage" traction was more heavily built than the ordinary traction-engine.

Both classes of traction-engine were obtainable in either single-cylinder or compound versions, and

A "single-cylinder heavy haulage traction engine with belt-driven dynamo" built in 1896 "for travelling showmen, etc."





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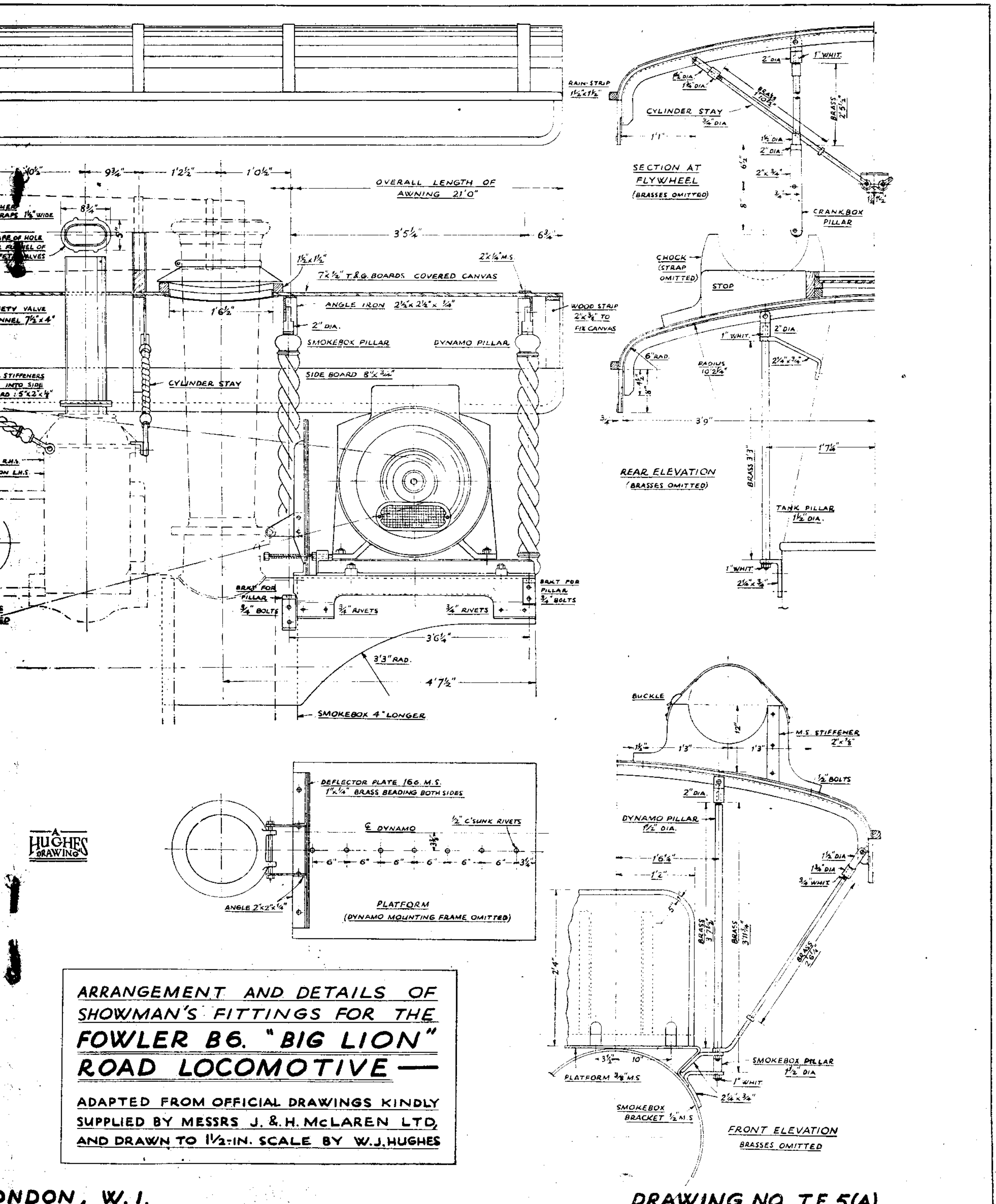

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that shown is, of course, a single. The " showman's fittings " are of the simplest—merely a dynamo platform bolted to the smokebox, and a larger flywheel than standard in order to give steadier running. Note that this flywheel is of the spoked type, with a separate plate fitted, " to avoid frightening horses."

Incidentally, the first Fowler showman's engine to be equipped with a dynamo had the latter mounted on a platform over the crankshaft, and driven from the flywheel by friction. This proved to be unsatisfactory, chiefly because of the oil flung up by the motion, and the forward mounted dynamo with belt drive became standard.

Drawings of Fowler Showman's Fittings

The general arrangement drawing of the " Big Lion " which was reproduced in the October 16th article was taken from my 1½-in. scale blueprint (obtainable from THE MODEL ENGINEER office), and this in turn was made from official drawings supplied by Messrs. J. and H. McLaren of Leeds. The engine represented is of the period 1909-10, but unfortunately when I asked for official drawings of the showman's fittings for that period, they were not available.

However, Messrs. McLaren kindly supplied drawings of a later period, but it would not have been much use simply reducing these to 1½-in. scale to act as a companion sheet, so to speak, to the blueprint of the locomotive. The trouble is that, owing to alterations in the design of the " Big Lion " during the intervening period, there are differences in quite a few of the dimensions—for example, in the distances between the pillars supporting the awning or canopy.

It must be emphasised, therefore, that the drawings of the showman's fittings have been adapted to fit the earlier prototype. This is not so satisfactory as if the drawings of the correct period had been available, but in the circumstances it is the only solution. Certainly, they do represent correct Fowler practice, and since the basic design is the same, that is the chief consideration.

General Arrangement of Canopy

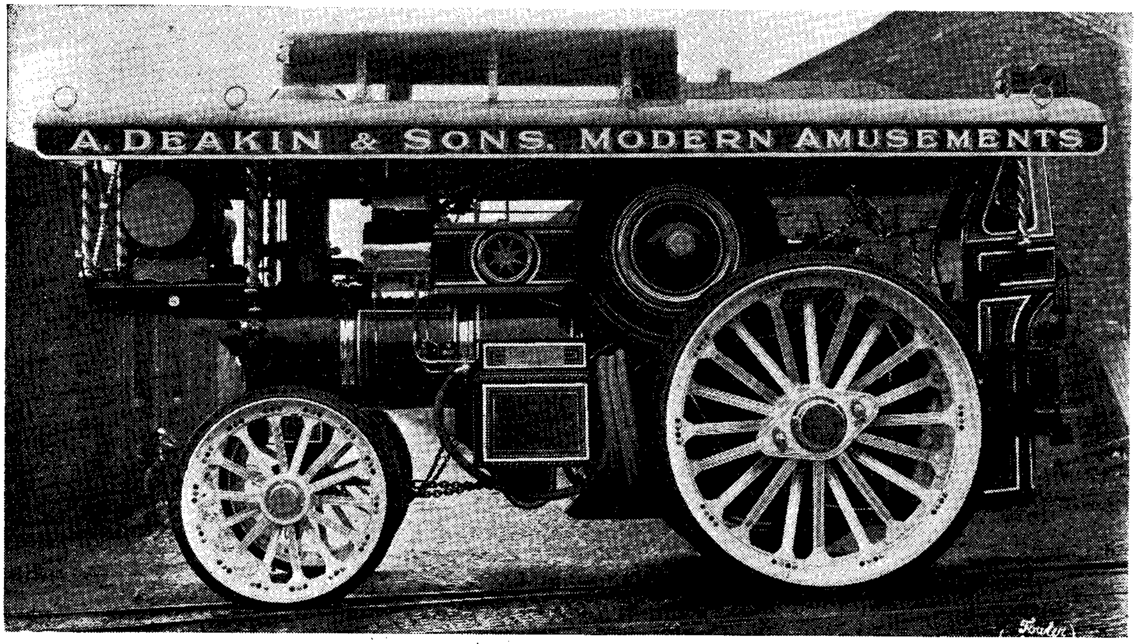
The canopy or awning is supported by eight pillars of the familiar twisted brass appearance; from front to rear, they are: the dynamo pillars, smokebox pillars, " crankshaft box " or hornplate pillars, and tank or tender pillars. In addition, from the tops of the hornplate pillars there are two stays leading forward to the cylinder block, and a further pair of diagonal stays are fixed transversely to the front top of the cylinder block and to one of the canopy angle-irons. Another pair extend from the feet of the dynamo pillars to the outer edges of the canopy. The purpose of these six stays is, of course, to brace the awning in both directions.

In addition, some engines, of which it will be seen *Supreme* was one, had diagonal braces fitted between the dynamo pillars, while others had a pair of diagonal braces either between the tender pillars, or from the feet of these pillars to the outer edges of the canopy, similar to those at the dynamo pillars.

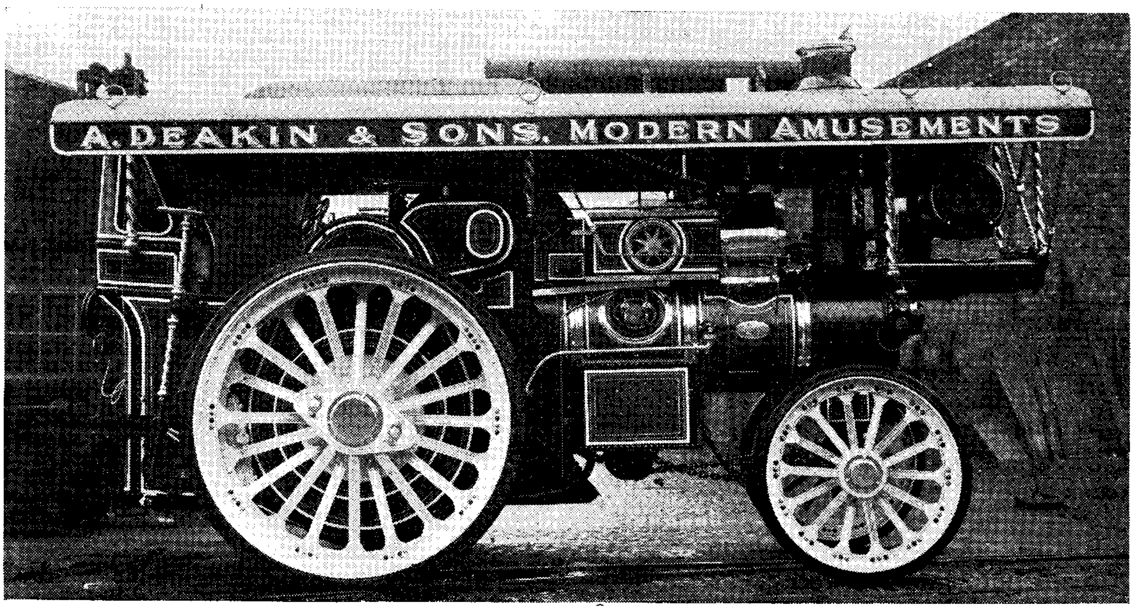
The photographs of *Supreme* are reproduced by courtesy of John Fowler & Co. (Leeds) Ltd.

The pillars themselves are of mild-steel, in two parts: the upper part is a nut which holds the decorative brass tube and knobs in place, while the lower end of the pillar is shouldered and threaded, to pass through the hole in its bracket and being secured by a nut and split-pin. However, the crankbox pillars are forged flat at their bottom ends, and are bolted to the front (spectacle or bridge plate) of the crankbox. The upper nuts are made flat on each side, and a bolt passes through the flats and through one of the curved angles on which the canopy is built.

These angles are of 2½ in. × 2½ in. × ¼ in. section, and the top of the



" *Supreme*," No. 20223, *Mrs Deakin's engine which was the last of the showman's road locomotives built in* 1934



The other side of " Supreme " ; in comparison with Drawing No. T.E.5 it will be noticed that this engine has several features of difference

awning is of planks 7 in. wide by $\frac{1}{2}$ in. thick. The planks are covered with canvas, and then 2-in. × $\frac{1}{4}$-in. mild-steel strips are fixed outside, coinciding with the angles, and having $\frac{1}{2}$-in. cup-headed bolts through all. The canvas is turned under the ends of the canopy, and secured by wooden strips screwed on.

The side-boards are 8 in. × $\frac{3}{4}$ in., and are bolted to the ends of the angles. The latter do not extend to the edges of the side-boards, but mild-steel strips are let in to the boards, coinciding with the angles, in order to reinforce them.

Three wooden chocks or cradles are mounted on the awning to support the extension chimney, which is secured in position by leather straps: a stop is fitted behind the chimney, and the cradles have 2-in. × $\frac{1}{8}$-in. steel straps " bolted through " on each side to reinforce the " short grain " of the wood.

A sliding shutter is provided in the awning for ventilation purposes, sliding between two strips of wood screwed to the two longitudinal side-pieces. The awning is also cut out at the rear to clear the crane turret, and openings are cut for the chimney and for the brass funnel for the safety-valves. The chimney opening is surrounded by a $1\frac{1}{2}$ in. square section strip, lined with a small angle worked from 20-gauge steel, and a conical cover is clamped to the chimney to keep rain out. On earlier engines the opening was frequently simply covered by a thin steel plate screwed in position.

The extension chimney, 8 ft. long, is made from sheet steel, rolled round and riveted at the seam, with a half-round beading at the top and near the bottom. In use, of course, the extension served a two-fold purpose; first it supplied extra draught when the engine was working quietly, and secondly it carried smoke and sparks higher up, and away from the crowds and the canvas tents of the side-shows.

Dynamo

Various dynamos were fitted, that shown in the drawing being a fairly modern type as fitted to later engines. It is bolted to a cast frame, which in turn is bolted to one of sheet steel. The cast frame or platform incorporates " rails " and adjusting screws so that the belt tension may be kept correctly adjusted.

The sides of the steel platform are bent over, and cut away to form lugs which are riveted to the smoke-box extension. A central line of countersunk rivets is used also.

At the rear of the platform, and bolted to a steel angle riveted to the platform, is the deflector plate which protects the dynamo from the heat of the chimney. This plate is made from 16-gauge mild-steel, but is strengthened by two angles riveted to the side nearest the chimney, and by 1 in. × $\frac{1}{4}$ in. beading riveted at both sides of its edge. Two lugs are bolted to the angles, and are supported by the bolt by which the chimney is hinged.

A cast brass Fowler nameplate, with raised letters and margins, is used to adorn the front of the dynamo platform, and in the latest machines the engine's name was carried on plates at the sides of the platform. In earlier engines the engine name was carried on the motion covers, where the ornamental eight-pointed star and ring are shown in the drawing. Talking about the ring and star, note that on the fly-wheel side these are further forward, because of the flywheel.

Crane Turret

When the " scenic " or switch-back type of ride, such as the Venetian Gondolas or the Dragons, was introduced into the fairgrounds, it became desirable to have a portable crane to handle the heavy cars, which weighed up to thirty hundred-weights. And what was more natural than to adapt the showman's engine for this purpose ?

Of course, many engines were not so adapted, and you may prefer to leave the crane fittings off your model. If so, the turret should be left off, and diagonal braces fitted to the awning at the rear, as previously mentioned.

(Continued on next page)

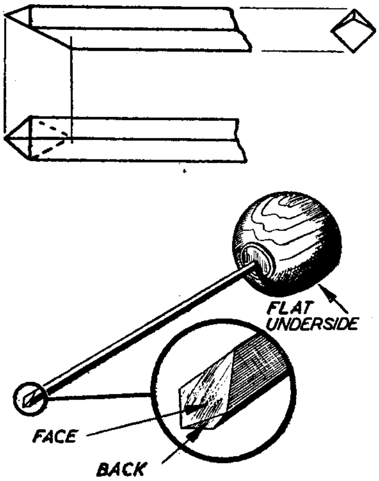
READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

HAND ENGRAVING

DEAR SIR,—Your correspondent, Mr. Wallace Bolton, has tried to do something which calls for skill far greater than he could acquire in an hour or two.

I am a skilled general engraver, and can assure him that it takes an apprenticeship and many years to achieve the skill required. I have 42 years as an engraver behind me, but am still learning from some things I have to do.



As regards the tools Mr. Bolton has, he mentions that the points come off frequently.

This is because when you buy these, they are dead hard and need tempering to a light straw.

He also says he has trouble in keeping a clean edge. Well, sometimes on certain metals even skilled men have the same trouble, with all their training. I imagine that he is using the gravers without any relief on the backs. The two back edges should be sharpened to raise the back portion slightly for clearance purposes.

Anyway, he says the gravers are of diamond shape. These are definitely wrong for the job he is doing. They should be square section. For his purpose, I show here, by sketches, what a graver should be like when whetted up for ordinary purposes. They should be quite short and shallow.

As you will no doubt realise, the subject of engraving (hand work) covers a pretty large field and a large number of tools are used of different kinds. The graver is the basic tool and with this only, an engraver *can* do all the work covered by all the others, but it would be a very slow job, and that, more or less, is the reason for many extra kinds of tools.

Langdon Hills. Yours faithfully, HERBERT E. W. WHITEHEAD.

EARLY TELEGRAPH INSTRUMENT

DEAR SIR,—I have a Wheatstones Universal Dial Telegraph instrument (transmitter and receiver) which has been in my family for many years, but owing to children playing with it, the transmitter is out of order. Bring fairly certain that the trouble originated in two or more of the keys being forcibly and simultaneously depressed, the instrument was taken in hand by a radio expert, who was unfortunately unable to see the fault, or to put it together again.

In this rather unpromising state it was shown to an experienced telephone mechanic, who very kindly offered to study the problem. Although the electrical principles are clear to thim, the mechanical layout is not obvious from the collection of parts which confront him, and we wonder whether any of your readers can say where a *mechanical* diagram of this instrument may be found. We have the description in *Discoveries and Inventions of the XIXth Century*, Routledge, 6th Ed., 1884, but this is not enough. Any hints as to how to reassemble the machine would also be appreciated.

Yours faithfully,
Penrith. H. A. ILLINGWORTH.

HOME FOUNDRY WORK

DEAR SIR,—If any of your readers is thinking of making the high-pressure spray gun described by Mr. Terry Aspin, there is no need to make the nose of the pattern egg-shaped, nor is there any need for pumping the metal when hot as suggested by Mr. Norman F. Hodges. If the gate pin is placed on the highest point of the pattern the problem is solved. All you have to do when the metal is cool is saw off the gate pin, dress with file and start machining.

Yours faithfully,
Stirling. DAVID AITKEN.

TALKING ABOUT STEAM

(Continued from previous page)

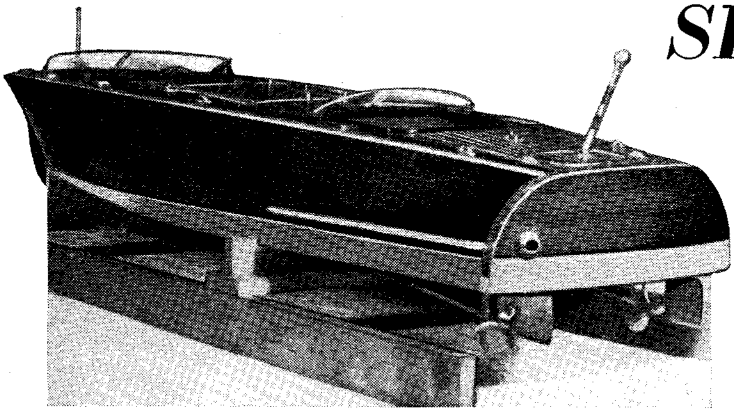
The side members of the turret are flanged from steel plate, and are riveted inside the bunker sides, with flat steel plates riveted on at front and back to form the coal bunker. At the top a steel platform is built, to which is secured a steel casting carrying one of the pulleys which guide the winding rope. The other guide pulley is carried on a cast steel bracket riveted to the back plate of the turret. Incidentally, the top ends of the tank pillars of the awning are stayed to the turret by means of the brackets shown in end elevation, which are forged from $2\frac{1}{4}$-in. × $\frac{3}{4}$-in. mild-steel.

Further discussion of the crane fittings had better be postponed until next time. Meanwhile, by the time this appears in print, the second sheet of drawings, No. T.E.5 (B), of the showman's fittings should be ready, and obtainable from Noel Street. The first sheet, No. T.E.5 (A), which incorporates the drawings reproduced in this article, is also available, as is No. T.E.5, which is of the "Big Lion."

All the drawings are to $1\frac{1}{2}$-in. scale, which is the best for most model engineers. It gives an engine which is not *too* large and heavy to handle, and which does not take up too much room in the modern house. It should be capable of hauling a good load, and—very important—the hind wheel teerings can be machined in the gap of the average $3\frac{1}{2}$-in. lathe. The boiler-too, is not beyond the capacity of the average amateur workshop.

A model Hackercraft

SPEED BOAT

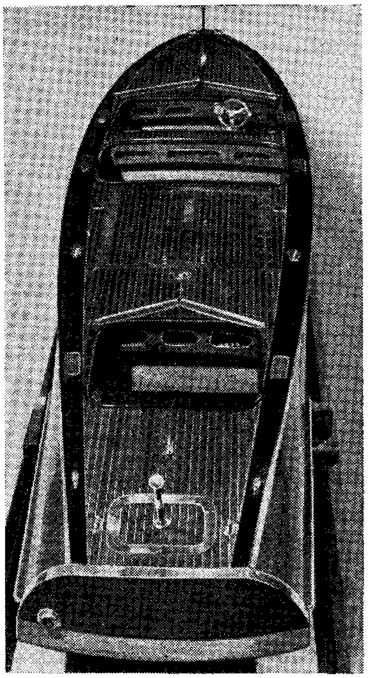


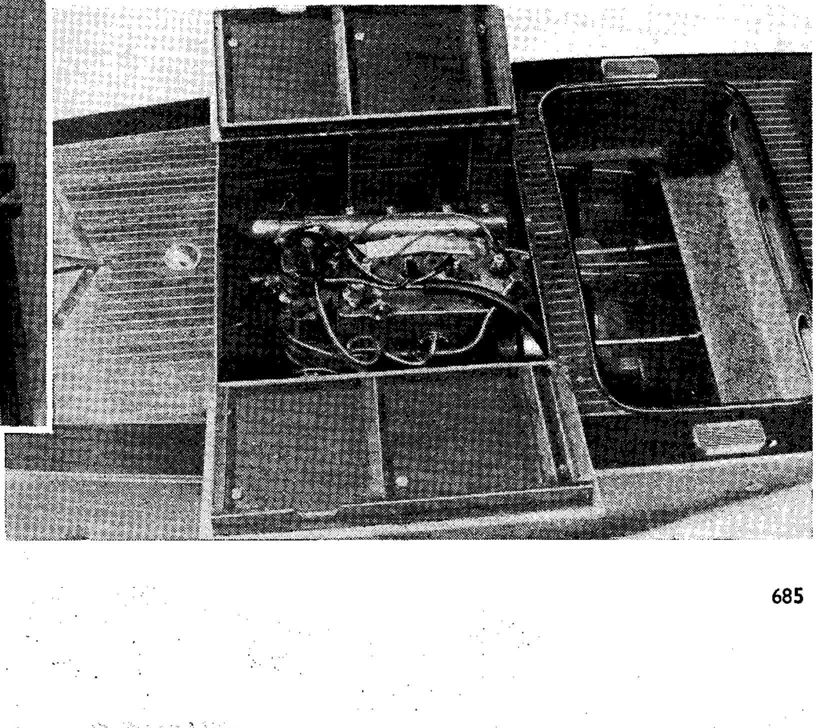
By John E. Minty

Some time ago, we received from Mr. John E. Minty, of Michigan, U.S.A., some photographs and a brief description of a speed boat he has built. From the photographs it will be seen that the boat has fine lines, and is a beautiful example of craftsmanship, and from the description it is obvious that the power plant and its accessories are on a par with the external appearance.

THE photographs show a small Hackercraft speed boat 66 in. in length, which is fitted with a 50 c.c. Wall 4-cylinder, 4 cycle engine which runs very nicely. The boat has a V-type drive contained in a cast aluminium gear case which includes also a cone clutch and a reverse gear. The steering gear is of the usual rack-and-pinion type and works nicely. This, with a small wrist watch made into an instrument board clock, and a geared sump pump, rear mast light, cockpit light and forward running light, together with leather upholstering, makes a complete and attractive looking model. The gearbox ratio is two to one forward, i.e., propeller speed is one half engine speed, which at 6,000 revolutions will develop, according to Mr. Wall, about one horsepower, the engine being 1-in. bore and 1-in. stroke. So the propellers turn at that speed—3,000.

Considerable pains were taken to make it an attractive working model. As yet it has not been given a full speed test on a sufficiently large body of water though it has been run very satisfactorily in a small tank. This was done to get the proper balance. The hull is made of 3-ply mahogany veneer, and the boat is very strong and light and has given no signs of leaking. The propeller shafts are $\frac{3}{16}$-in. drill rod, and the thrust is taken on two small radial ball bearings combined with the stuffing boxes. Two flexible couplings bridge the gap between the inboard-end of the propeller shafts and the gearbox. The boat is $\frac{1}{8}$-in. scale, the offsets having been obtained from the Hackercraft people in Detroit, Michigan, and reduced to the scale of $1\frac{1}{2}$ in. to the foot, the original boat being about 45 ft.





The graceful lines of this craft can be seen in the above photograph

Right—View of engine

A Research MICROSCOPE

by Lawrence H. Sparey

SHOULD any professional engineer glance at the drawings which accompany this article, he may well wonder why—if the microscope is such a precision instrument—the measurements are given as *fractional*, rather than in decimals, with the plus and minus limits to which he is accustomed. Strangely enough, the required accuracy does not lie in a precise following of set measurements, but rather in the correct alignment of slides, and the "squareness" of one component to another.

Furthermore, in one-off jobs each of which is a complete unit in itself, the chief concern is that the components are a good fit one to the other, and a few thous. either way is usually neither here nor there. Doubtless my drawings could have been smothered with decimal points, with half-thou. limits on the slightest provocation, and this would have ensured that a foot made by a reader in Glasgow would be a perfect fit to a limb made by another in Taunton ; yet I doubt if either instrument would be the better for it.

This being so, it is to be taken for granted that builders will adhere as closely as possible to the measurements given, but will be mostly concerned with the close mating of one component to another. In those instances where a close limit is necessary the measurements will be given in decimals of an inch.

Materials

As stated in the last article (see the April 23rd issue of THE MODEL ENGINEER), the original microscope was made almost entirely of brass, but the appalling cost of this material at the present time—especially as the castings for the limb and foot weigh almost 12 lb.—has led me to investigate further. I have discovered that at least one world-famous manufacturer of microscopes makes the limb and foot of his instruments in cast-iron, a procedure which we ourselves will follow. In addition, I have made entirely new patterns which allow for all recesses to be cast in, so that all deep internal milling has been obviated.

The machining of the two surfaces upon which the slides for the body-tube and for the substage are mounted is really the only part of the machining of the whole instrument that is likely to be found difficult. The reason for this is that these two surfaces must be parallel and in line with each other, which means that really they should both be machined at the one setting. Unfortunately, the average 3½-in. lathe will not allow this to be done, because the travel of the cross-slide is insufficient to allow complete milling from the headstock. This means that two settings must be employed, entailing very careful setting-up. For this reason I have arranged with the suppliers of the castings that these parts may be supplied with the vital faces ready-machined. If, however, you possess a milling machine or a shaper, the matter is simple.

In spite of the difficulties of *milling* the faces of the limb on a small lathe, I have, following my usual belief that anything not actually bigger than the lathe can be machined in it, devised a successful method of *planing* the faces true. In addition to the fact that the travel of the cross-slide is too short, the matter is further complicated because the casting is too long to allow it to be swung on the headstock. Therefore some means had to be hit upon whereby the casting could remain stationary and the tool moved to a different position to compensate for the lack of cross-slide movement.

In the photograph, Fig. 1, I have reset the finished limb of my instrument in the manner in which it was originally machined. Here it will be seen that the casting is held in a machine vice which is bolted to the faceplate of the lathe. The mandrel has been locked by engagement of the backgear. To the cross-slide has been bolted a vertical slide, which carries a small steel block in which a planing tool

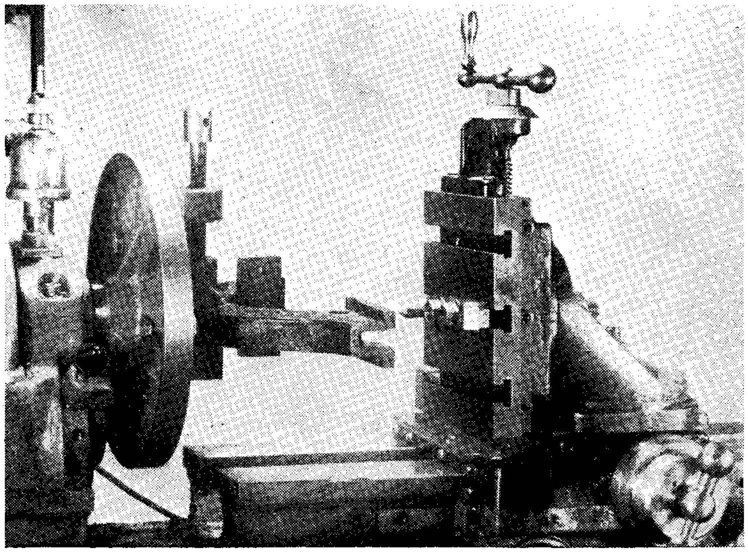


Fig. 1. Method of planing the faces of the limb on a 3½-in. lathe, to ensure accuracy of alignment

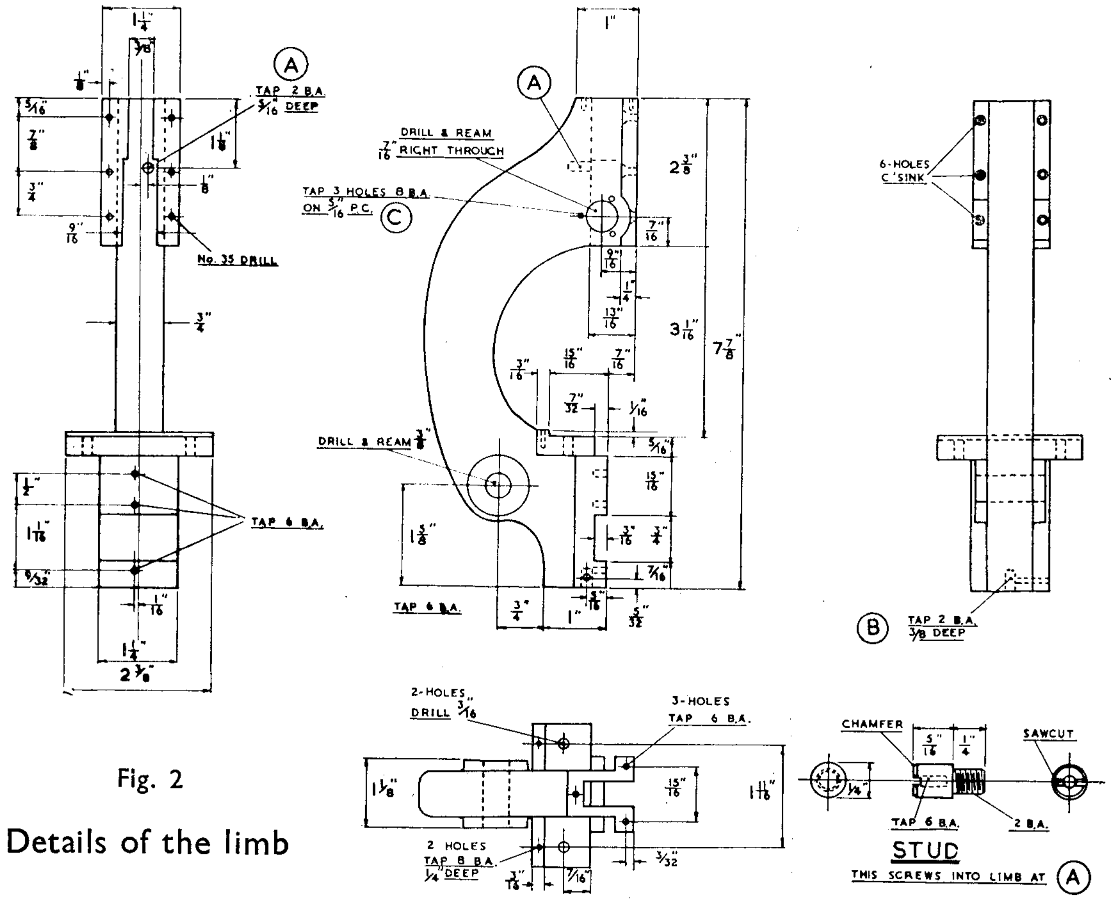


Fig. 2

Details of the limb

is clamped. The lathe carriage should be engaged with the leadscrew and fed forward by this means. From the picture it is obvious that, if the tool is fed forward, a small amount, the faces of the casting may be planed by movement of the cross-slide, the tool being lowered after each stroke by means of the vertical slide. The recess, being cast in, will need no machining.

When the first face has been planed, the vertical slide is removed bodily from its present position, and bolted down in exactly the same manner to the furthermost slot of the cross-slide. Thus, in spite of the inadequate travel of the slide, the tool is brought into position for machining the further face of the casting, which is somewhat hidden in the photograph. The casting itself is, of course, not moved during the whole operation.

The vertical face, at right-angles to those just machined, is very plainly shown in the picture, and may be machined by using an offset tool; controlling the feed with the lathe leadscrew, and planing by movement of the vertical slide.

Preparing the Castings

Planing the castings by the above method is rather a tedious process, and much can be done to relieve this by a careful preparation of the castings before any machining is attempted. The aim should be to rely upon the machining only as a truing-up process, requiring very light cuts.

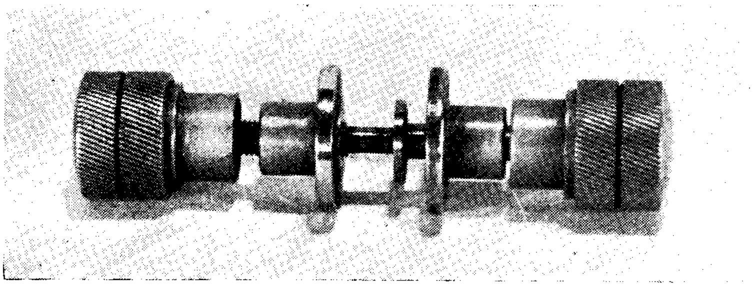
When the castings have been obtained, they should most certainly be immersed in spirits-of-salts for about ten minutes. This is necessary to remove any traces of moulding sand which may still linger. It does, also, serve to soften, to some extent, the hard skin which often arises on cast surfaces. The castings must be well washed in several changes of water.

Now, with a file, clean the casting up thoroughly; at the same time, the surfaces to be machined may be filed down to almost their finished sizes, provided that care is taken to check them for rough flatness and alignment. This leaves the very minimum for the tedious shaping processes.

The foot presents no difficulties, as the only machining required, apart from drilling and tapping, is that on the faces of the slot, and on the base of the feet. This latter may well be done with a file, and checked on a flat surface to ensure that the foot stands firmly.

It is advisable when reaming the $\frac{3}{8}$-in. holes for the pivot bolt, to mount the castings together, and ream both sets of holes in one operation.

In Fig. 2 a great number of drilled and tapped holes are indicated; it is advisable not to drill these at the moment, but to wait until they can be spotted through from the



The slow-motion movement, shown as it would be assembled within the limb

various components which they will secure. If they are drilled now it will mean that a great deal of careful marking-out and drilling will have to be done later. It is, in fact, necessary only to put in the holes marked *A*, *B* and *C* at this stage.

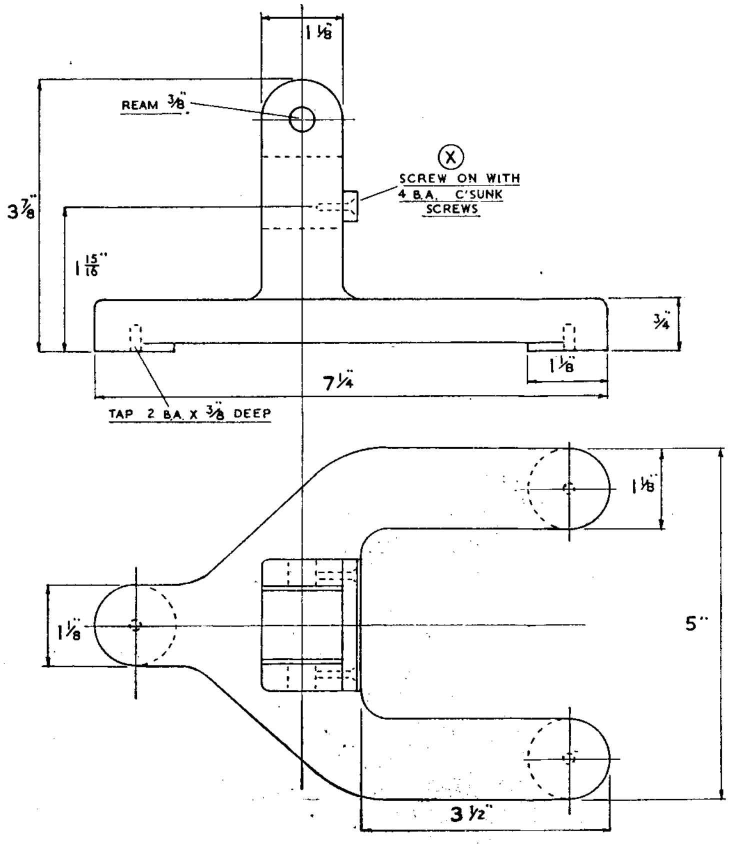
Slow Motion Movement

It may seem rather odd at this juncture to describe the slow motion mechanism, but as this actually fits within the casting, to do so may save referring back at some later time. The exploded view shown at the top of Fig. 4 explains the method used. To begin with, it must be understood that the bushes *B* and *D* are located and screwed to the limb at the point shown as *C* in Fig. 2. They are, in fact, provided with small registers which locate in the $\frac{7}{16}$-in. holes. While one of the bushes has a plain bore, which slides on the shank of the spindle, the bush *B* is threaded to correspond with the threaded portion of the spindle. The knobs *A A* are simply screwed up hard on to the ends of the spindle, and serve only as a means of turning it.

It will be obvious that if the knobs are revolved, the spindle *C* will be screwed in or out of the bush *B*, thus imparting a cross-movement to the small disc which the spindle carries. This, in turn, will move the hanging lever *F*, which will lift or lower the block *E* which is attached to the slow-motion slide. This slide is spring-loaded to keep pressure always upon the lever.

In the drawing, and on the prototype microscope, the thread on the spindle is 60 t.p.i. and this will impart a movement of approximately 0.005 in. (wrongly stated as 0.0015 in. in my last article) per revolution of the knobs. As there may be some difficulty in obtaining a 60 t.p.i. tap for the bush, this thread may be made 40 t.p.i. if desired, without unduly coarsening the adjustment of the instrument. The movement will then be 0.0075 in. per turn, and little perceptible difference will be noted in operation.

(*Continued on page* 693)



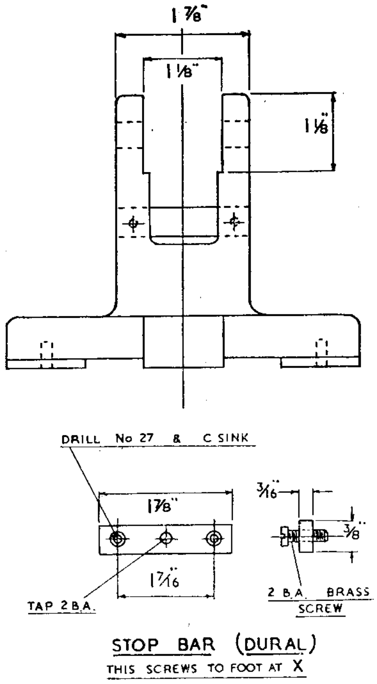


Fig. 3

Elevations and plan of the foot

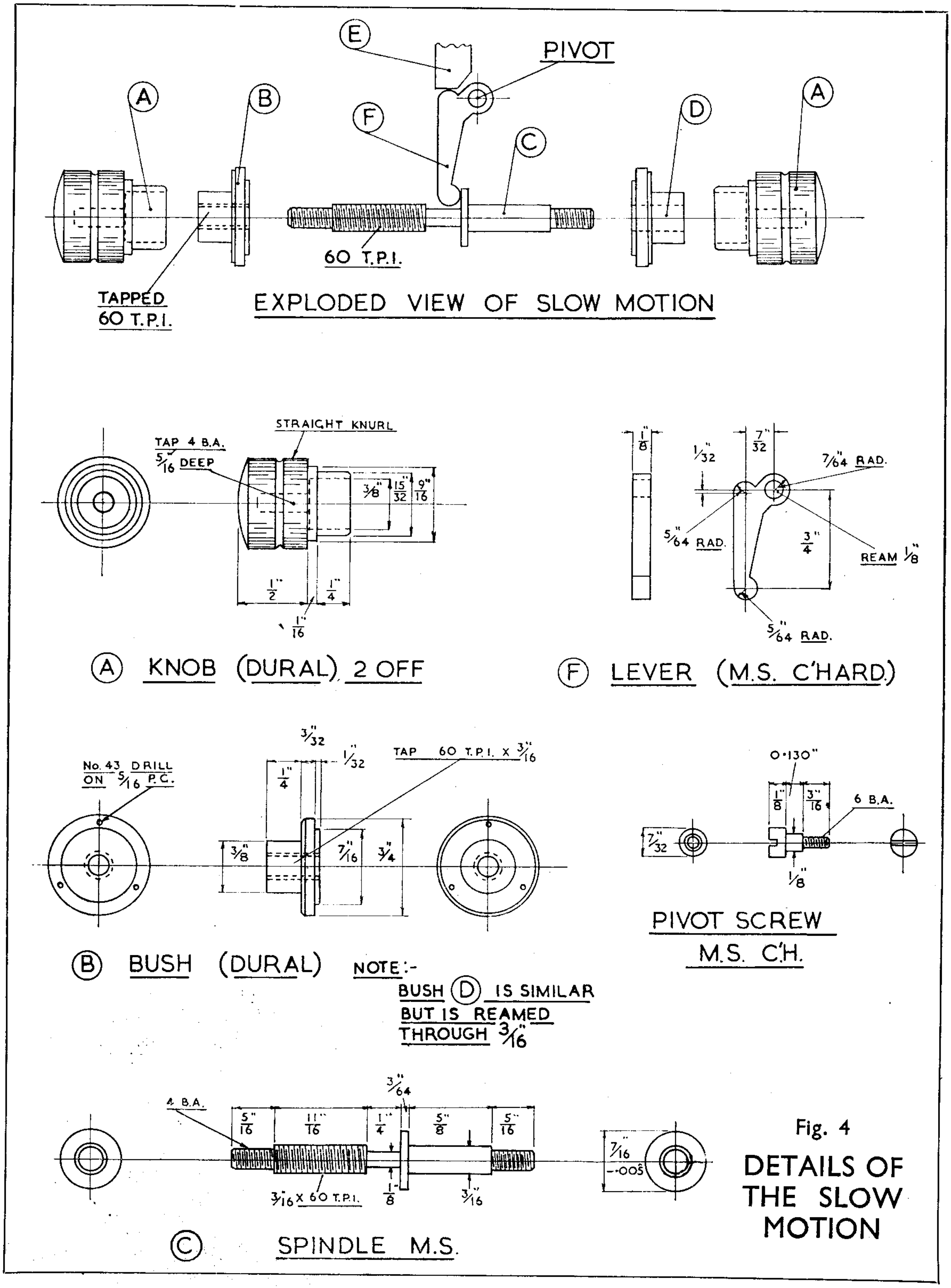


Fig. 4
DETAILS OF THE SLOW MOTION

IN THE WORKSHOP

BY DUPLEX

AN OVERHEAD FOR THE LATHE

THE overhead drive described in the previous article is also suitable for use with the Myford ML7 bench-mounted lathe; but, where this lathe is mounted on a cabinet stand, the overhead illustrated in Figs. 1 and 2 is designed to take the place of the former arrangement. As will be seen, two angle-steel uprights, braced by three stretchers, form a frame for attachment to the back of the cabinet stand. Where a swarf tray is fitted, the necessary clearance is obtained by means of distance-pieces. To obtain a rigid fixing to the sheet-steel cabinet, the uprights are bolted as close as possible to the top and bottom of the stand and at points where the reinforcing strips have been built in. In order to increase the bolting surface, large steel washers, some 2 in. square, are fitted inside the cabinet under the bolts. As with the previous overhead, the uprights were made from steel angle-material that formed the side members of a disused bedstead, but this should be checked to see that it is straight and square and will afford a true seating for the bearing blocks. The two uprights rest directly on the floor and their weight is, therefore, not borne by the cabinet itself. As the overhead shaft is not at any time heavily loaded, plain-bearing plummer blocks, secured directly to the uprights, are used instead of self-aligning ball-bearings. The bearings illustrated have light alloy bodies fitted with oil-retaining, bronze bushes.

The driving shaft consists of a length of $\frac{3}{4}$ in. diameter centreless-ground, mild-steel shafting, end-located in the bearings by a pair of shaft collars. As before, the overhead shaft is driven from the lathe motor-driven countershaft; but, to carry the driving pulley, the latter shaft is either fitted with an extension or a new and longer shaft is used.

Two miniature V-belts, type F. 5504, running on specially-made 4 in. diameter pulleys, take the drive from the countershaft to the overhead shaft. These belts, as well as the plummer blocks, can be obtained from Messrs. A. & F. Mountain, 307, Borough High Street, London, S.E.1.

The belt-tensioner is carried in a sliding block (*A*) and consists of a weight, and a weight-shaft to which

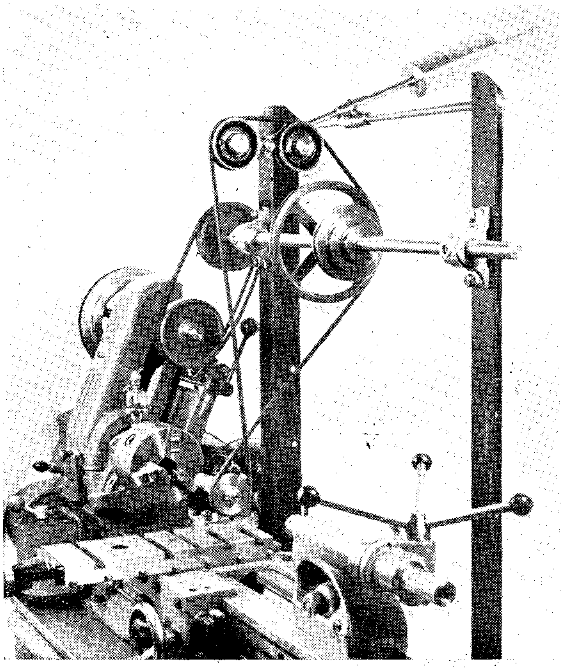


Fig. 1. *The overhead fitted to the Myford M.L.7 lathe*

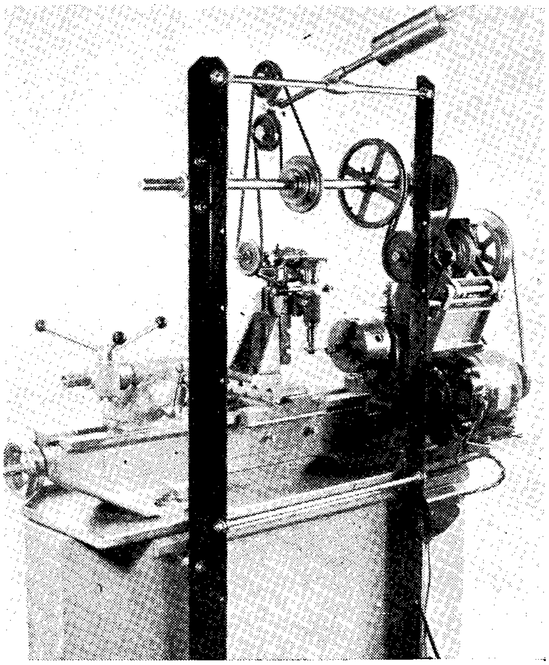


Fig. 2. *The overhead seen from behind the lathe*

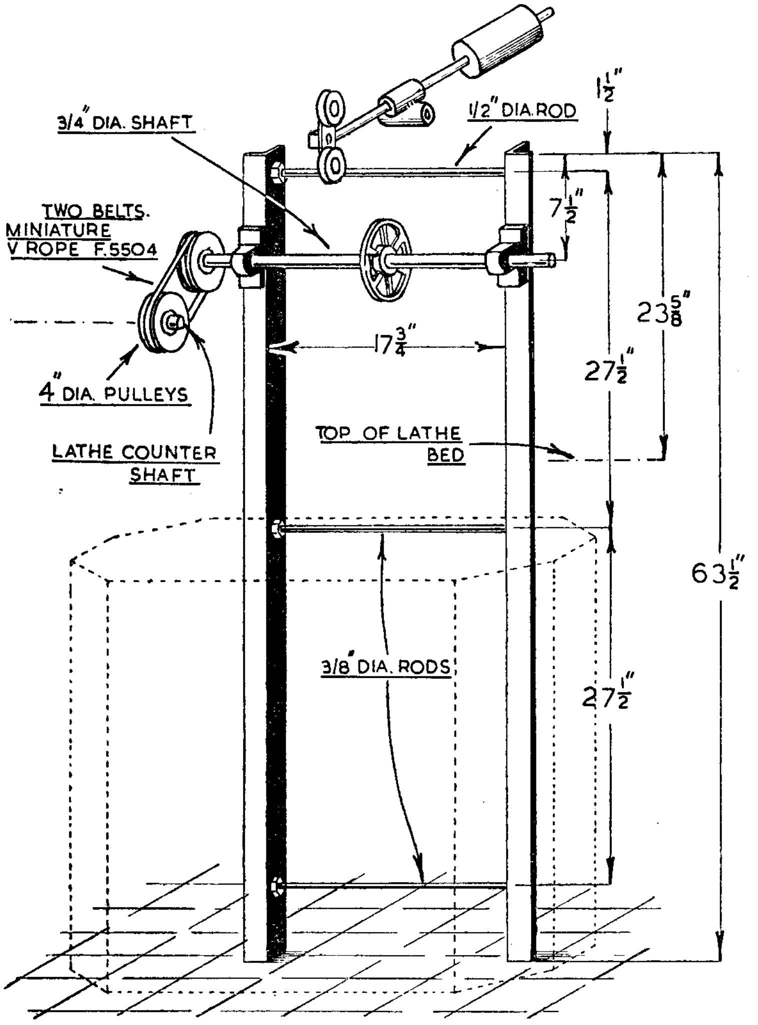


Fig. 3. General arrangement of the overhead drive

is attached the plate (*D*) with its two jockey pulleys.

Material will be saved if, lacking a suitable casting, the slider (*A*) is fabricated from two short lengths of mild-steel rod.

The two parts are, in turn, gripped in the lathe chuck and drilled axially to the reaming size of the finished bores.

To prepare the parts for brazing, the lower is formed, either by filing or milling, with a curved recess to fit the upper.

As it is important to keep the two parts in alignment during the brazing or silver-soldering operation, it is advisable to secure them by means of a well-fitting, steel peg. After brazing, the bores are finished to size with a reamer.

The Weight and Weight-shaft

The weight (*B*) is made from a length of mild-steel bar; but to save expense, a scrap-end of iron bar could be used, or a length of tubing will serve when filled with lead, either by casting in the metal or by adding lead shot.

Where the tubular form of construction is adopted, the weight can be located on its shaft by means of two shaft collars fitted with set-screws. The steel bar is gripped in the four-jaw chuck and the axial hole is machined either with a long drill or with a D-bit, but the projecting end of the work may have to be supported in the fixed steady, as illustrated in Fig. 6.

The two jockey pulleys run on the studs (*E*), attached to the plate (*D*), and each is retained by a set-collar. The split clamp-block (*F*) is secured to the weight-shaft by means of an Allen cap-screw, and the plate (*D*) is held in place by a nut and conical washer.

The Jockey Pulleys

These were machined to a good finish from some rough, commercial pulleys made, presumably, for fitting to window sashes; nevertheless, they were found to be of good quality cast-iron and were easy to machine.

The Primary Drive

The drive from the motor-driven, lathe countershaft is by means of a pair of V-belts running side by side.

For mounting the double-V pulley, an extension-piece was fitted to the lathe countershaft. Although there are several ways of machining this shaft in the lathe itself, the easiest

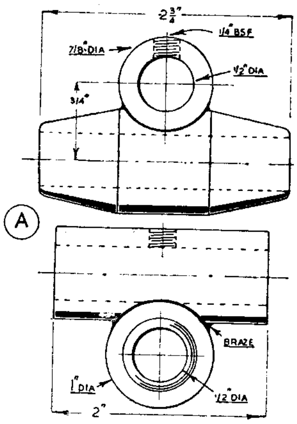


Fig. 4. Sliding carrier for the belt-tensioning gear

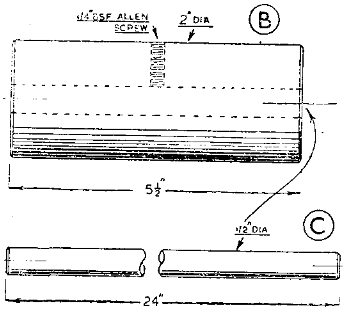


Fig. 5. B—the counter-weight; C—the weight shaft

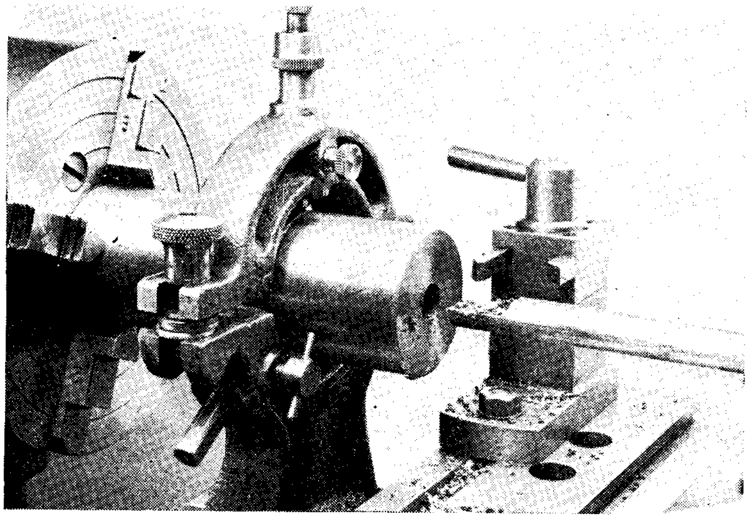


Fig. 6. Boring the weight with a D-bit

and it has been in use for many years without giving any trouble.

The Double-V Drive Pulleys

The machining of single-groove V-pulleys has been described in a previous article, but a few hints on machining the double-groove variety may not be out of place, for it is important to space the grooves correctly and make them of equal depth. After the pulley has been bored to size, it is mounted on either a taper or a stub mandrel, supported by the back centre. The centre of the finish-turned rim is marked-out with the jenny calipers, and a fine line is then scribed right round with a V-tool to serve as a guide for spacing the belt grooves. When machining the grooves, as shown in Fig. 12, a sheet-metal gauge is used to check both the depth and the included angle. The pulleys are finally secured in place with

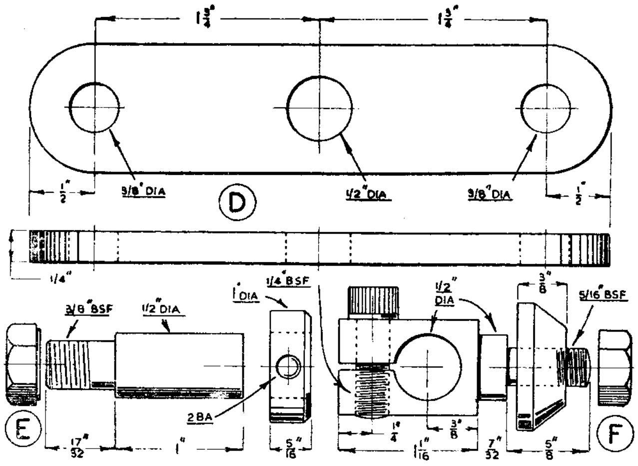


Fig. 7. D—the jockey pulley plate ; E—the pulley stud ; F—the shaft clamp

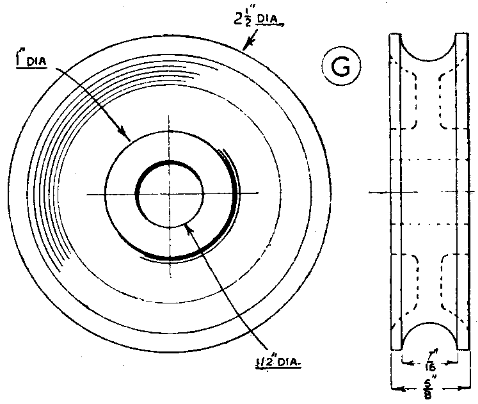


Fig. 8. The jockey pulleys

perhaps, where a second lathe is not available, is to borrow a similar shaft from a friend in a like predicament; both shafts can then be machined in turn and the lender will be duly recompensed. To ensure true-running, it may be found advisable to fit an oversize extension-piece and to turn it to the finished diameter after assembly. When the work is properly carried out and the parts closely fitted, the shaft should stand up quite well to all ordinary driving strains, and cross-pinning is hardly necessary, except where the direction of rotation tends to unscrew the parts; in fact, we have an electric motor fitted in this way with an extension to the armature shaft,

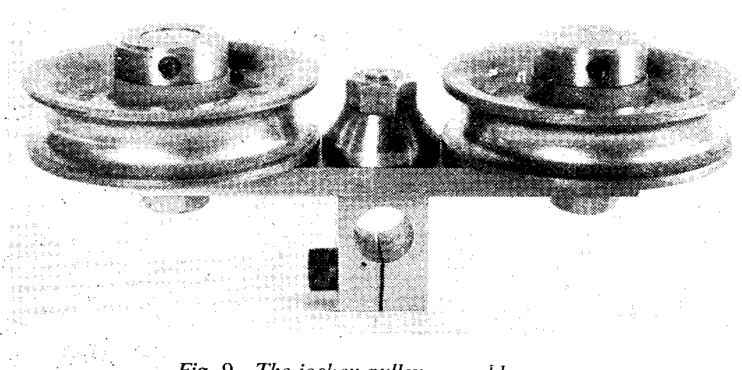


Fig. 9. The jockey pulley assembly

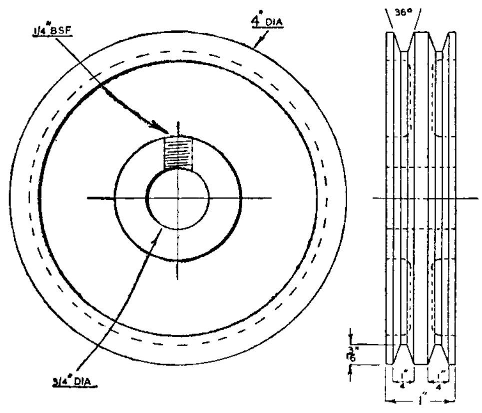


Fig. 11. The V-groove driving pulleys

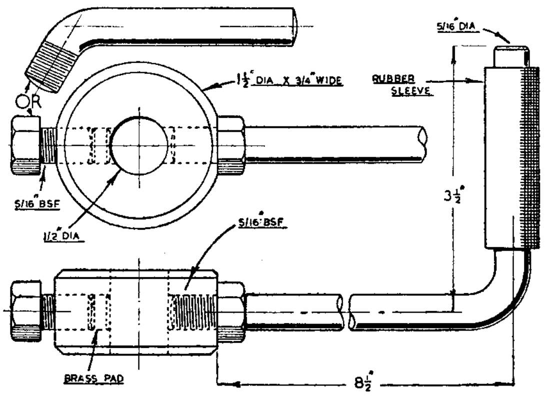


Fig. 14. The stop-collar and arm for controlling the weight shaft

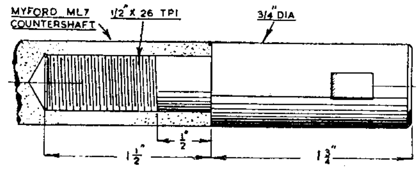
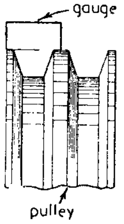


Fig. 10. The countershaft extension-piece



Right—Fig. 12. Gauging the pulley grooves

pulley can be aligned and then locked to its shaft. Where greater movement of the lathe saddle is required for machining longer work, it will be better to adopt the customary arrangement of fitting the driving pulley with two long keys, so that it can slide freely on the driving shaft and maintain the belt alignment automatically.

Allen grub-screws engaging a flat filed on the shaft.

The Final Drive

For light, high-speed drives, the ordinary sewing machine leather belt will be found satisfactory. The joint is made either with a U-fastener or by cementing and stitching.

Should the belt break or leave the pulleys, the weight fitted to the belt-tensioner may swing round and cause damage; but this can be prevented by fitting a stop-collar to the shaft, and the collar is adjusted to limit the movement of the weight to a $\frac{1}{4}$ in. or so. As, with this arrangement, the turning moment acting on the stop-collar remains constant irrespective of the length of the stop-arm, the arm illustrated in Fig. 13 will remain equally effective if reduced in length; nevertheless, the longer arm probably has a better cushioning effect in the event of the weight accidently falling.

Most milling work undertaken in the lathe calls for only a small amount of saddle traverse, which is not enough to interfere materially with the alignment of the driving belt on the pulleys.

In these circumstances, the driving

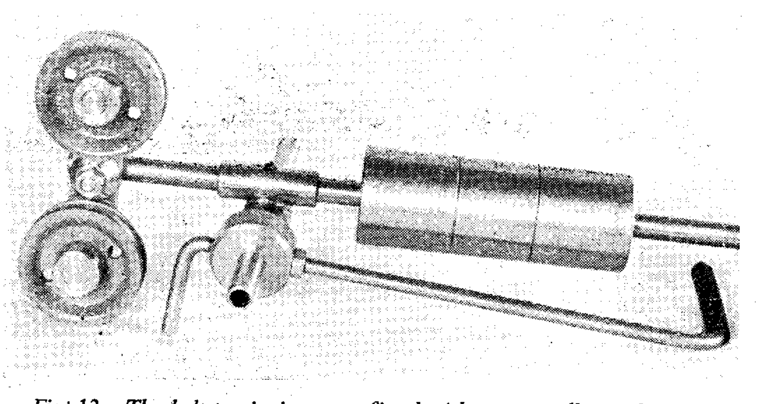


Fig. 13. The belt-tensioning gear fitted with a stop-collar and stop-arm

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A RESEARCH MICROSCOPE

(*Continued from page* 688)

Returning again to Fig. 2, we note the stud *A* which screws into the limb casting at the bottom of the recess as indicated. Into this stud screws the pivot-screw, shown in Fig. 4, and it is upon this screw that the lever hinges. The details given, together with the photograph and drawings should give a clear picture of the slow motion arrangement.

Materials

It will be noted that dural has been specified for a great number of the parts shown. In the original, all these parts were of brass, afterwards chrome plated. Brass is, of course, the orthodox material, and builders may care to use this in place of the dural. The latter has, of course, the advantage that it can be buffed up in the home workshop and needs no further finishing. Were I constructing another instrument, however, I should undoubtedly use *stainless-steel* for all bright parts. This would be a little trouble to obtain, and more difficult to work, but what a job it would make!

(*To be continued*)

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Power for Air Compressor

I have a twin-cylinder compressor of 1.816 *in. bore by* 1.375 *in. stroke, which is driven by a 230-volt, ½-h.p. high duty motor running at* 1,425 *r.p.m., the drive being by V-belt, to give* 880 *r.p.m. The motor seems to get more than normally warm in a short while when maintaining a pressure of* 40 *lb. per sq. in. I am using a container of approximately* 1 *cu. ft. capacity. Will this be suitable for carrying out continuous cellulose spraying? The compressor had no valve plate when I obtained it, so I made one of alloy steel ⅜ in. thick with valves of flat steel shim ½ in. diameter operating over a ring of ⅛-in. holes.*

As I have no information as to the correct type of valves for the compressor I should be glad of your advice as to whether this type will be satisfactory. The cylinder-head is of the two-compartment type, both inlet valves opening to one compartment and both exhaust valves to the other.

W.A.H. (Fleet).

The motor you have fitted to your air compressor plant should be capable of supplying sufficient power for the work you require. Some types of motors are designed to work at a fairly high temperature, but if the temperature of the motor continues to rise when in use, or there is any smell of scorching, it indicates either that it is overloaded or that there is some electrical fault.

The load on the motor will, of course, depend upon the pressure maintained by the compressor, and presumably, you will not want to maintain as high a pressure as 40 lb. for cellulose spraying. The valves you have fitted to the compressor appear to be quite sound, and valves of this type are very commonly used, but a good deal will depend on the details of their arrangement and fitting.

The size of air container you suggest would be suitable for continuous spraying.

Annealing Light Alloy Sheet

I propose to make four overhead troughs, each holding four 150 *watt bulbs for lighting a recreation hall. I have available some* 24*-s.w.g. "Alclad" sheet. A standard type wiring machine, hand operated, is available. Please tell me how I can anneal the edges of the sheet for wiring, and will edge wiring strengthen the trough sufficiently? The total length of the trough will be* 3 *ft. Will ⅛-in. wire be suitable for wiring the edges?*

W.P.J. (S.E.1.)

We are of the opinion that the method of construction which you suggest will be quite practical. The "Alclad" sheet can be annealed by heating it to the required temperature and quenching in water. This is usually done by means of a salt bath, but in cases where this is not available, it is possible to indicate the temperature by marking the sheet with ordinary soap, and heating it until the soap turns black.

If heated beyond this temperature, the metal may melt or become brittle. The thickness of the material suggested should be suitable for your purpose.

Truing a Flywheel

I have a four-spoked wheel with a 1¼-in. rim of the type as used on sewing machines, etc. It was purchased second-hand about two years ago, and left in my workshop. It ran quite truly when first obtained, but when I went to use it recently, I mounted it on a spindle, and found it has sprung out of truth. Will you please explain how the wheel can be straightened?

N.V.S. (Penarth).

You do not say what material the wheel is made from, but we presume that it is cast-iron, as you say it is the type used on sewing machines.

There is not a great deal that can be done to set the wheel true, as it would not be possible to bend cast-iron, though it is possible that if the rim is definitely buckled it could be clamped between two heavy steel discs, and heated, and then annealed by slow cooling, which might effect a remedy. Generally speaking, however, with cast-iron, the only thing that can be done is to re-machine the wheel after initial distortion has taken place.

If there is no perceptible distortion of the rim itself, the solution might be to clamp the wheel on a faceplate, setting it true over the outside of the rim, and rebore the centre hole, a bush being fitted if necessary to accommodate it to the original size of shaft.

Taper Turning Between Centres

I have seen a formula for taper turning which gives

$$\frac{\text{length of working} \times \text{taper/in.}}{2}$$

and I have had difficulty in putting this into practice.

What is considered as the length—the length of work, or the length of actual taper? Also, which way should the tailstock be off-set, toward or away from the operator?

D.H. (Timsbury, nr. Bath).

We do not believe in attempting to apply a formula to this operation, as in general practice it is often found much quicker to work by trial and error, that is to say, taking trial cuts and making measurements at given distances on the work. Any attempt to work to a formula is complicated by the fact that the exact point of contact of the centres with the work would be extremely difficult to measure accurately.

With regard to the length that should be measured to assess the taper, we would point out that in most cases where this method is applied, the taper is stated in fractions or decimals of an inch per foot. For instance, if working on a taper of ½ in. to the foot, and the length of the taper is 3 in., the dimensional differences at the two ends of the taper will obviously be 1/8 in.

In cases where the small end of the taper is towards the tailstock, as in most operations of this nature, the tailstock should obviously be displaced towards the operator. We would further point out that there are practical difficulties in the accurate measurement of tapers, and in the absence of a special gauge, it is usual to fit the taper by trial to the socket with which it is intended to mate, using marking colour to indicate the high spots, and correcting the taper if necessary until it makes contact over the full length of its bearing surface.